

AMERICAN JOURNAL OF OPHTHALMOLOGY

THIRD SERIES FOUNDED BY EDWARD JACKSON

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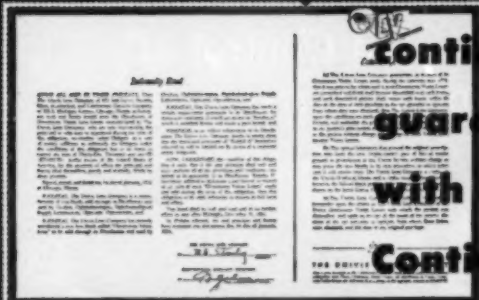
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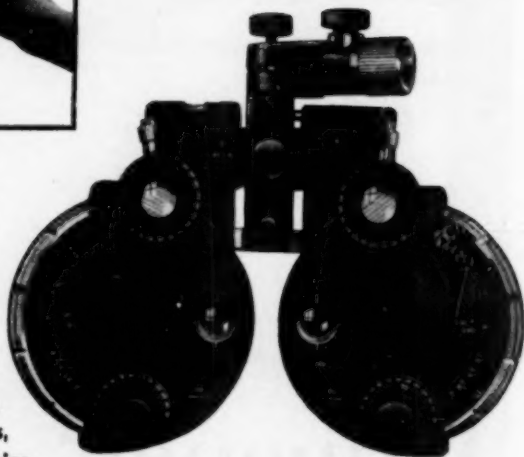
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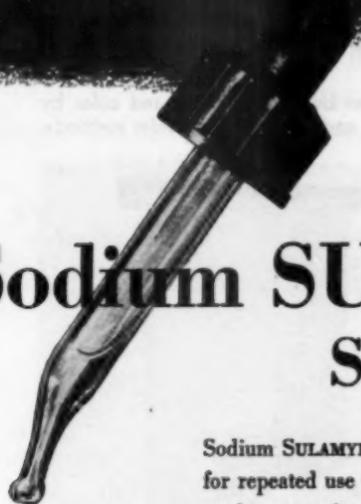
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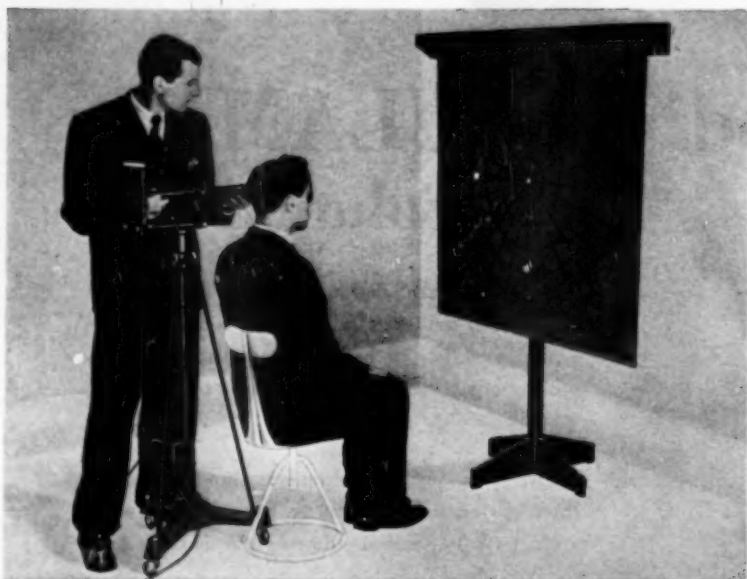
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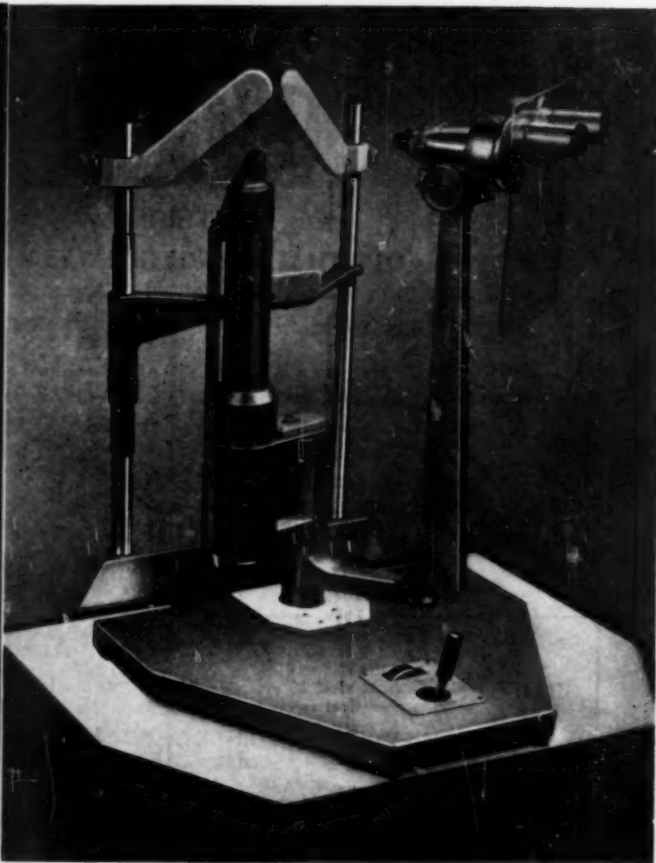
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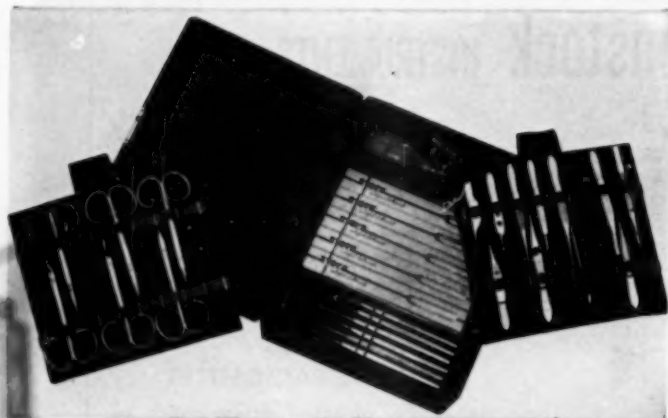
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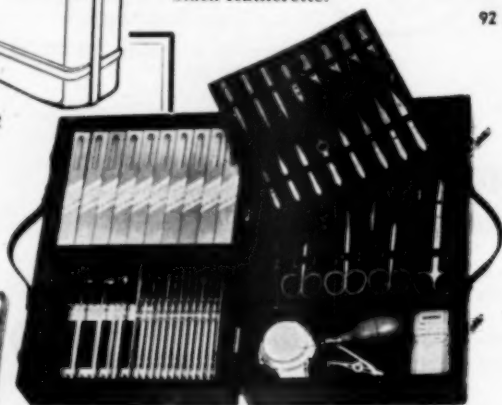
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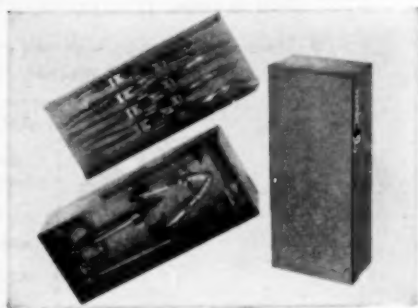


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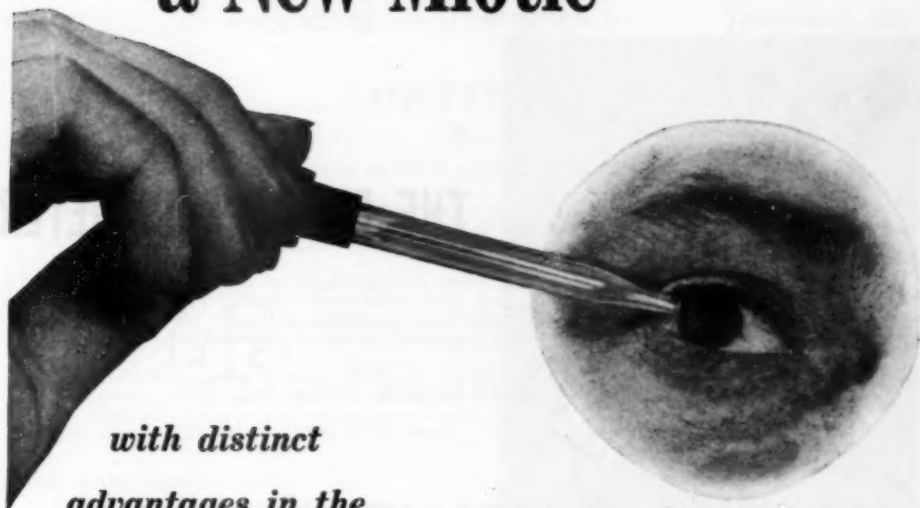
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AMERICAN JOURNAL OF OPHTHALMOLOGY

SERIES 3

VOLUME 35

NUMBER 1

JANUARY, 1952

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ABSTRACTS

Diagnosis and therapy; Ocular motility; Conjunctiva, cornea, sclera; Uvea, sympathetic disease, aqueous; Glaucoma and ocular tension; Crystalline lens; Retina and vitreous; Optic nerve and chiasm; Neuro-ophthalmology; Eyeball, orbit, sinuses; Eyelids, lacrimal apparatus; Tumors; Injuries; Systemic disease and parasites; Hygiene, sociology, education, and history	131
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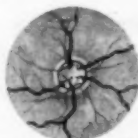
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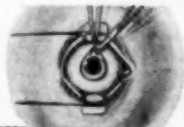
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AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 35

JANUARY, 1952

NUMBER 1

THE PHASIC VARIATIONS IN THE OCULAR TENSION IN PRIMARY GLAUCOMA*

THE SIXTH PROCTOR LECTURE

SIR STEWART DUKE-ELDER
London, England

Among all branches of knowledge ophthalmology cannot be said to have been lacking in enthusiastic disciples who, to the virtual exclusion of all else, have found joy in serving her. To this the English-speaking world has been no exception; and therein it has always been a tradition that service has had its complement in generosity. In my country there are several examples of such generosity; in yours one of the most outstanding and important is the memory which this lecture keeps fresh—the memory of the service of Dr. Francis I. Proctor and the generosity of his widow, Elizabeth C. Proctor. For this reason the endowment of a lecture such as this is of great spiritual benefit inasmuch as it interweaves the factual basis of our science with the interest and warmth of human affection.

Nor are the benefits of such generosity confined to spiritual things: for the Proctor Foundation for Research in Ophthalmology in this university has served as a focal point for the growth of our science on the West Coast—that youngest part of America now advanced into ophthalmologic maturity—and in countries beyond the boundaries of your own the advances it is creating are being watched with interest and admiration.

To have the opportunity to come from the other side of the Atlantic, and pay tribute to the spirit of this lecture and to the enthusi-

astic and increasingly important work in our specialty now emanating from this university, is a privilege such as has rarely been offered to me. I thank you sincerely for this honor you have accorded me; and—a matter of more importance—I am glad to have the opportunity of thanking you for the inspiration to high endeavor that this foundation and the spirit with which it is associated are spreading far beyond the confines of your own country, wide though they are.

I have the great privilege at present of being in the position to direct and coördinate the work of a team of enthusiastic young people† who are studying intensively the clinical evolution of cases of glaucoma at the Institute of Ophthalmology in London, associated with Moorfields Hospital, and correlating their observations with experimental physiologic work on the intraocular pressure in the laboratory. I want to make it clear at the outset that the credit for the observations I am about to describe is, in the main, theirs.

We have now over 350 patients with all types of glaucoma under review at both the pre- and postoperative stages, and not only is their ocular condition assessed by every

† Those who have worked especially on the subject of this lecture are D. A. Langley, S. J. H. Miller (London), R. K. MacDonald (Toronto), T. L. Thomassen (Oslo), W. Leydhecker (Frankfurt), and H. Swanljung (Helsinki). Most of the expenses incurred by them have been met from a grant by the Alexander Pigott Wernher Memorial Trust Fund to which I am greatly indebted.

* Presented at the University of California School of Medicine, San Francisco, September 14, 1951.

means at our disposal, including such specialized investigations as campimetry and gonioscopy and their response to the various provocative tests, but attention is paid to their general medical condition, particularly their cardiovascular reactions, their psychologic state, and their environmental difficulties.

To be of real value, studies of this type will require to be extended over many years and involve many more cases; but we are gradually accumulating information much of which, I think, will be of value and some of which is surprising. From this information I propose in this lecture to single out one aspect and explore where it is leading us; and I have chosen the subject of the diurnal variations of the intraocular pressure because I believe that it concerns itself with one of the most fundamental aspects of the disease.

THE NORMAL DIURNAL VARIATION

It is an old and established observation that regular phasic variations occur in the intraocular pressure of most normal eyes throughout the 24-hour period of the day. This rhythm was first discovered by Maslenikow,¹ in 1904, and the subsequent studies of a very considerable number of observers² have now established its existence and its essential

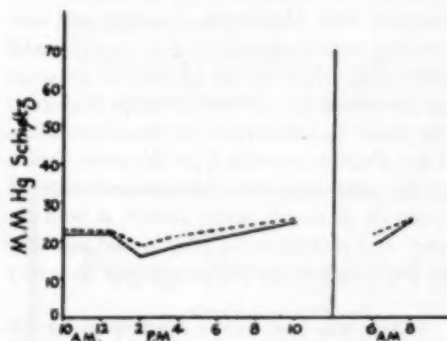


Fig. 1 (Duke-Elder). The normal variation of the ocular tension. (In this and all succeeding figures: Ordinates indicate ocular tension as mm. Hg (Schiotz) [X-tonometer, uncorrected]; abscissae, the time in hours: The vertical line indicates the time when the patient was asleep. Continuous line: R.E.; dotted line: L.E.)

characteristics. Figure 1 illustrates a typical variation.

I know that the average variation is small and that tonometry is a relatively inexact method but, when the same instrument is used upon the same eye, the readings acquire considerable significance. It is true, also, that a few cases occur wherein a diurnal variation cannot be elicited; but the great majority of normal people show a rhythm, alike in each eye, rarely exceeding 5.0 mm. Hg (Schiotz), with maximal and minimal values occurring at any time throughout the 24 hours but generally showing a rise in the morning and a fall thereafter.

It is not without interest that this is the reverse of the usual diurnal variation in the blood pressure which depends upon bodily activity and on the average tends to fall during sleep at night and is usually at its maximum in the afternoon.³

While the existence of these changes in the ocular tension is generally admitted, their cause has given rise to some controversy, and a number of theories have been advanced in explanation, each of which has failed to withstand close inspection.

That they are due to a redistribution of blood involving a hyperemia during the night from postural or other causes is disproved by the facts that the curve is unaltered by bodily posture or activity, that the peak of the pressure curve often occurs during the day, and that its incidence is unaffected even if the patient's habits are suddenly reversed and he remains up at night and spends the day in bed.

The suggestion that osmotic changes in the blood due to eating and exercise are the determining cause is disproved by the circumstance that the rhythm is unaffected by rest or work, by changing the times or the richness of meals, or by feasting or fasting.

Several observers have suggested that the size or movements of the pupil have a bearing on the matter, a dilated pupil obstructing the angle of the anterior chamber and hindering the flow of aqueous; but it has

been found that the rhythm occurs whether the pupil is fixed in dilatation or contraction by atropine or pilocarpine, if the continuity of the iris is broken by an iridectomy or a coloboma, or even if this tissue is absent in aniridia.

Any action of light upon the ocular capillaries is negated by the same monotonous persistence of the rhythm if a brilliant light is maintained all night and the day is spent in darkness.

Others have suggested—and in an impulsive moment, I was one of them—that massage of the eye by muscular movements through the day aided the circulation of the intraocular fluid and lowered the pressure of the eye, while the relative immobility during sleep has the opposite hypertensive effect owing to stagnation of the aqueous humor; but again, the maintenance of the characteristic rhythm of the pressure despite the reversal of habits has disproved this.

The only circumstance in fact which has been shown to alter the incidence of these oscillations is a long-term and fundamental change of habits. Raeder⁴ showed in cases of secondary glaucoma that, if a complete reversal of the sleep habit were established over some time, a similar reversal of the variation in ocular tension occurred.

It would seem, therefore, that all attempts to ascribe this phenomenon to local causes have proved illusory and it would appear that we must turn to something more fundamental for an explanation.

It would, indeed, seem most probable that the basis of these diurnal changes is associated with the rhythmic variations which so commonly occur both in vegetable and in animal life—affecting, for example, sleep, the temperature, diuresis, and other basic functions. It would seem that each individual has a characteristic rhythm which is obstinately maintained, and that both eyes habitually vary together, circumstances which make it likely that the periodic alteration is determined by a habitual hypothalamic rhythm imposed upon the organism by long-

standing environmental conditions, as probably are the similarly rhythmic functions of sleep, temperature, and diuresis.

It is known, for example, that the diurnal fluctuations of temperature⁵ and sleep⁶ as well as diuresis⁷ occur and persist independently of the maintenance or change of any external rhythm in the environment for some time. Thus the normal variation in temperature persists for a considerable period after the commencement of habitual night work and the diurnal rhythm of urinary flow similarly survives a uniform intake of fluid and the reversal of the sleep habit.

The fact that such rhythms as the diurnal variation in temperature are apparent in the newborn infant indicates that these fluctuations are very fundamental and probably innate, and it may be that they are ultimately determined both in vegetable and animal life by the profound influence exerted by the sun upon all nature.

This conception is, of course, somewhat hypothetical, but it would seem that a regulating mechanism must exist which tends to maintain the intraocular pressure at a physiologic level within a slight habitual rhythmic variation in spite of the numberless strains and stresses to which it is exposed in everyday life, and in spite of the drastic interference which operative procedures may entail.

VARIATIONS IN GLAUCOMA

If we turn now to glaucoma, one of the most interesting characteristics of the disease is the extraordinary excursions of the rhythmic oscillations in the ocular tension which occur in a great number of cases. It would seem reasonable to suppose that these are basically of the same nature as the variations in the normal eye; it would seem as if in glaucoma these became exaggerated and the tension periodically rises, regularly or irregularly, to a peak considerably above the base pressure in an ascending phase, to fall again to the base level in a descending phase.

An obvious hypothesis which may be ad-

vanced to account for these changes is that the glaucomatous eye has in some way lost the normal power of control so that the rhythmic changes run riot and a gross and uncompensated swing of the pressure occurs. However that may be, the fact remains that these phasic variations can be—and frequently are—quite astonishing in their amplitude. Until we investigated the subject fully over a large number of cases of every type of the disease, I myself had no conception of the drama of their nature.

A case of simple glaucoma may be under observation for a long period under miotics, be completely asymptomatic, and appear clin-

Hg (Schiotz). To me, and I think to many others, this state of affairs is surprising.

SIMPLE GLAUCOMA

These changes are best illustrated first from cases of simple glaucoma because the most regular rhythm is seen in this type of the disease. By simple glaucoma I mean the slowly progressive and insidious type of case characterized, in addition to the changes in ocular tension, by field defects and cupping of the disc from a relatively early stage of the malady, without congestion or episodic events, asymptomatic until its late stages or associated only with vague but constant visual

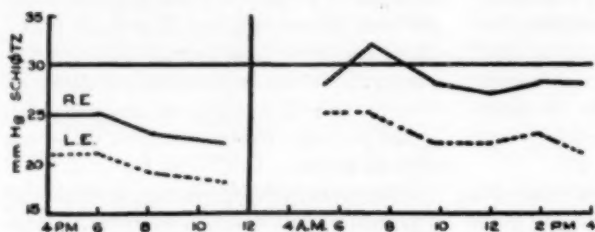


Fig. 2 (Duke-Elder). *Simple glaucoma*. The ocular tension showing a falling type of curve.

ically, so far as occasional observations of the visual acuity, the tension, and the fields are concerned, to be holding its own, habitually being seen at a time of the day when the ocular tension happens to be in a low phase, and at the same time, during a period of the day which is easy to miss because it is of short duration or occurs at an inconvenient hour, shows a swing in tension quite commonly of 10 or 20 mm. Hg (Schiotz)* and occasionally of 50 or 60 mm. Hg.

Similarly, a patient with congestive glaucoma may go on for years retaining a normal visual acuity and fields and without pathologic evidences in the optic disc, troubled only occasionally by transient attacks of halos, but systematic investigation shows that the appearance of the halos is accompanied by an acute and otherwise asymptomatic rise of pressure up to heights sometimes of 80 mm.

difficulties. In this type of the disease, the configuration of the angle of the anterior chamber seems to be of no significance for the proportion of cases with wide and narrow angles is statistically comparable with that found in nonglaucomatous individuals of the same age group.

My material is drawn from a series of cases intensively studied by Langley and Swanljung* in our institute, the patients being controlled by residence in hospital, miotics being stopped for the previous 24 hours and throughout the period of test, the tension being taken by the same observer and the same tonometer at two-hour intervals during the 24 hours except a period between 11 p.m. or midnight to 5 a.m. The investigation of such patients shows that very considerable variations in the ocular tension occur but these in general may be classified into three groups.

One relatively common type of change, comprising some 20 percent of the cases,

* All tension readings were taken with X-tonometer of Schiotz (uncorrected).

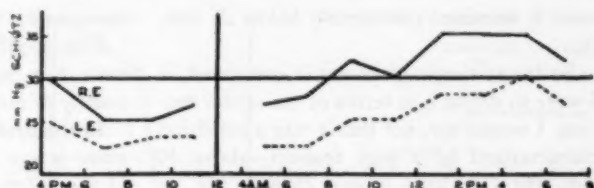
Fig. 3 (Duke-Elder). *Simple glaucoma*. The ocular tension showing a rising type of curve.

which I propose to call a *falling type* of curve, shows a single variation which in a sense may be regarded as an exaggeration of the normal curve: the tension is high on waking in the morning, usually reaching a peak soon thereafter and then gradually falls, often with minor fluctuations, until the last reading is taken about midnight (fig. 2).

The second group, which is somewhat commoner and comprises some 25 percent of the total, is in a sense the reverse of this and shows a *rising type of curve*: the tension is low in the early morning, climbs steadily with minor fluctuations throughout the day until between about 4 and 6 p.m. and then falls steadily throughout the evening and night (fig. 3).

The third group is the most common and comprises some 55 percent of cases; it shows a *double variation* in the daily curve which may, in a sense, be regarded as a combination of the other two types. Usually the tension rises in the early morning before the patient gets out of bed, reaches its peak in the forenoon (in this series usually about 9 a.m. and always before 11 a.m.) and falls to reach a minimum in the early afternoon; this morning rise is followed by a second rise at about 6 p.m., which declines steadily throughout the evening and night to start to climb again in the early hours of the morning. A variation of this type is seen in Figure 4.

It is interesting that in all cases, whether those of the falling type, the rising type, or those showing a double varia-



tion, there is a tendency for the tension to fall in the early evening after 6 p.m., a tendency which persists until the early morning (fig. 5). This general tendency characteristic of simple glaucoma seems to disprove the classical conception, stressed particularly by Thiel² (1923-1925), that the rise of tension occurred essentially during the night and was due to the congestive effects of decubitus.

The dramatic nature of these variations in simple glaucoma is seen in Figure 6, wherein each vertical line shows the variations between the peak and base tension in a series of 63 unselected eyes, affected with this type of the disease, which had not been subjected to operation either because they had recently come under observation or because they appeared clinically not to be deteriorating with miotic treatment.

In this series the greatest phasic variation was 45 mm. Hg and the smallest 5.0 mm. Hg (Schjötz). In general the higher the base pressure, the greater the phasic excursion. It is important that in 18 cases the tension was never above 30 mm. Hg—a significant proportion of almost 30 percent—and in two

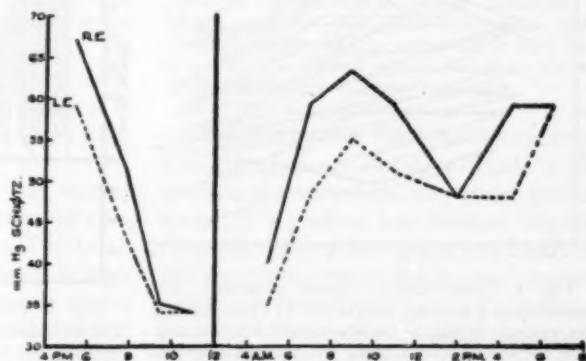


Fig. 4 (Duke-Elder). *Simple glaucoma*. Double-variation type of curve.

cases it remained consistently below 25 mm. Hg.

So far as simple glaucoma is concerned, if I were to define it in terms of the ocular tension, I would say, not that it was a condition characterized by a high tension—above 30 mm. Hg (Schiøtz), above 25 mm. Hg, or what you will—but that it was characterized initially by an instability of the ocular tension which shows a diurnal phasic variation of more than 5.0 mm. Hg, a state which usually—but not invariably—results in a permanent increase; in its early diagnosis the height of the tension is a secondary matter, for the disease can exist even if the tension is always below the level generally accepted as normal. From the point of view of understanding the enigma that is glaucoma, I think this is

fundamental and we shall return to it.

This rhythmic variation in simple glaucoma has certain characteristics which are worthy of note.

In the first place the rhythm in its general sense is not fortuitous but is characteristic of the individual. It is independent of blood pressure, of age, sex, and refractive condition, nor does it bear any relation to the width or narrowness of the angle of the anterior chamber, phases as great occurring with proportionate frequency in cases with wide as with narrow angles.

In the same person minor changes may occur from day to day but, by and large, the curve of tension retains its characteristics over periods of at least several months (fig. 9). If the same individual is tested again after an interval under the same conditions, the curve is sometimes identical; if it is not, it suffers minor alterations but retains the same general form, except that as the disease progresses the base pressure tends to rise and the phasic variations to be more sudden and abrupt in their character and to increase in their amplitude so that a case, which

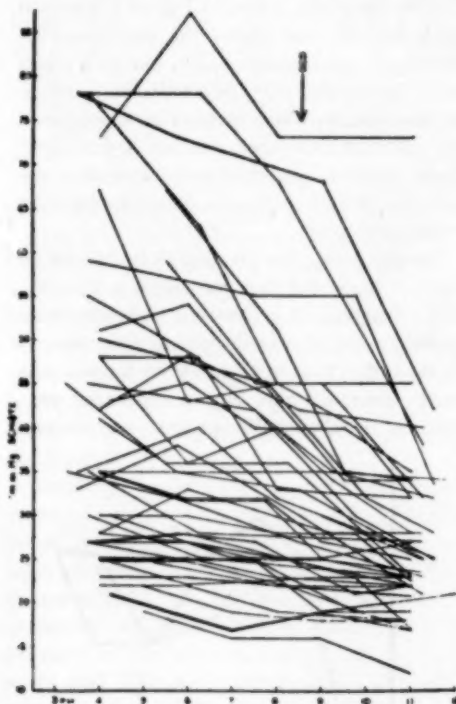


Fig. 5 (Duke-Elder). Simple glaucoma. The superimposed evening curves of 45 eyes showing the general decline in tension toward late evening. The arrow indicates bedtime for the community at 8:30 p.m.

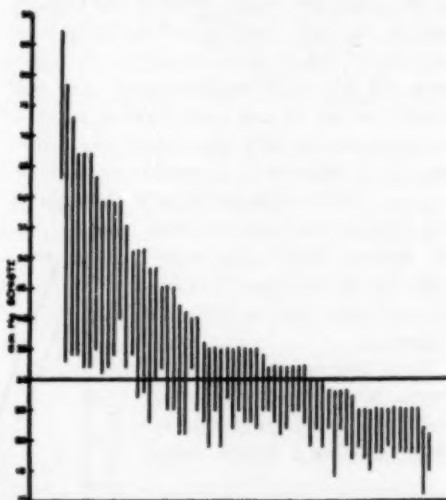


Fig. 6 (Duke-Elder). Simple glaucoma. The variation in tension in 63 unoperated eyes. Each vertical line represents the highest and lowest tension recorded during one day in an individual eye.

Fig. 7 (Duke-Elder). *Simple glaucoma*. To show the persistence of gross oscillations in the absolute stage. Right eye: absolute glaucoma, corneal edema, no perception of light. Left eye: small paracentral scotoma, vision 6/5.

originally showed a relatively small variation, gradually develops a more exaggerated rhythm.

It is generally stated that, as the disease approaches the chronic congestive or absolute stage, the phasic swing becomes progressively smaller, the base pressure approximating the peak pressure so that the two tend to merge. There is reason to believe that this does occur when organic changes block the drainage channels at the angle, but it is to be remembered that the disease may advance to a stage when all perception of light is lost while at the same time the phasic alterations in tension remain at a maximum (fig. 7).

It is of clinical importance that the oscillations in the two eyes of the same individual also tend to show the same fundamental characteristics. They may, of course, and frequently do, differ in degree, and in cases wherein the glaucoma appears clinically to be unilateral, an abnormal phasic variation in the apparently sound eye, having the same nature as the gross phases in its fellow which shows obvious signs of the disease, betrays the existence of an incipient stage of the malady, the presence of a fundamental instability which has not yet been sufficient to raise the tension significantly or cause functional damage (fig. 8).

It is also of unusual interest that, in general, the same individuality is preserved after a successful drainage operation. The variations are damped down and lower in their general form, but although muted in degree they are the same in kind—an indication that the operation, although it relieves the tension,

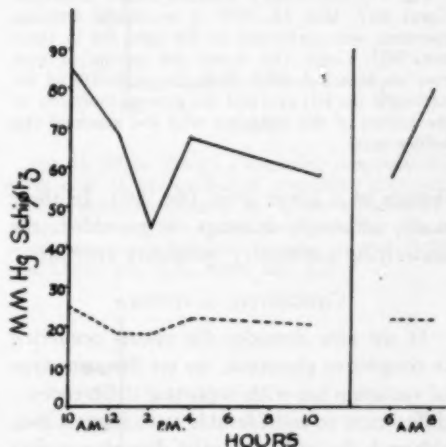
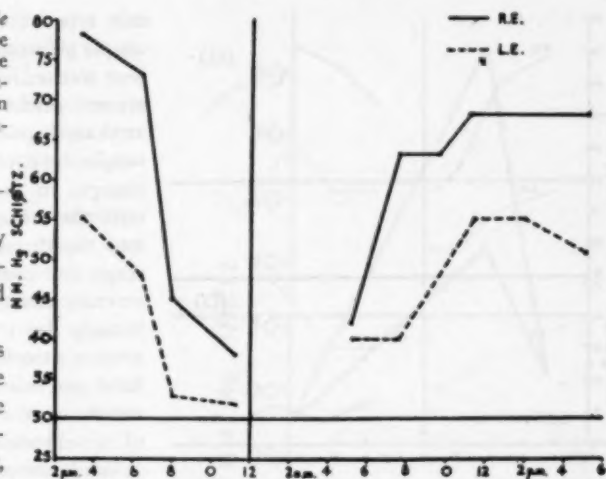


Fig. 8 (Duke-Elder). *Simple glaucoma*. A woman, aged 65 years, with wide angles. Right eye: absolute glaucoma, no perception of light. Left eye: clinically normal, vision 6/5. Note the resemblance of the two curves.

does not cure the fundamental condition (fig. 9). And an operation which is not mechanically successful may make matters worse; if a trephine hole becomes blocked, the oscillations of the tension may increase; and sometimes even if the drainage channel appears gonioscopically clear and a conjunctival bleb indicates free drainage, oscillations of considerable amplitude may persist al-

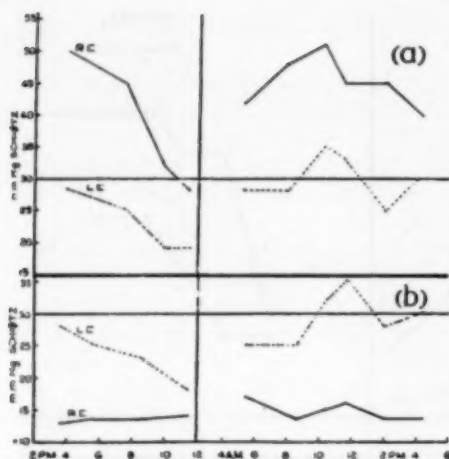


Fig. 9 (Duke-Elder). *Bilateral simple glaucoma.* Curve (a), May 12, 1950. A successful drainage operation was performed on the right eye in January, 1951. Curve (b) shows the tension of both eyes on March 3, 1951. Note the similarity of the curves of the left eye, and the general similarity of the curves of the right eye with the maximal rise before noon.

though at a lower level (fig. 10). In these cases, although drainage is provided, the underlying circulatory instability remains.

CONGESTIVE GLAUCOMA

If we now consider the events occurring in congestive glaucoma, we see the same type of variation but with important differences—differences so considerable as to suggest that, although the same essential disturbance may be operative, the mechanism of its action is different. By congestive glaucoma I mean

that type of disease which, in contrast to simple glaucoma with its insidiously progressive course, is episodic in its nature, which occurs preferentially in females of an anxious disposition at an earlier age than the simple type of the malady, that shows no changes in the visual fields or optic discs until the disease is far advanced sometimes into the chronic congestive or the absolute stage, that usually has a narrow angle of the anterior chamber, and that is characterized initially by irregularly occurring rises in tension associated with transient attacks of halos and mistiness of vision which may culminate in an acute and uncompensated attack of raised tension.

While simple glaucoma is slowly and insidiously progressive, congestive glaucoma is violent and turbulent in its course; the former causes blindness quietly almost before its victim is aware, the latter with all the tragic drama of a catastrophe.

The investigation of the tension in such cases shows a characteristic evolution which I will divide into three stages.

At first, and sometimes for many years, the tension is generally normal and only occasionally shows a sudden rise, particularly toward the end of the day and usually when the patient is tired or worried or excited—a family crisis, a business worry, an exciting game of cards, or a visit to the cinema are typical adequate stimuli.

Such a rise occurring as an isolated incident can frequently be elicited in the clinic in a case of this type by the ordinary dark-

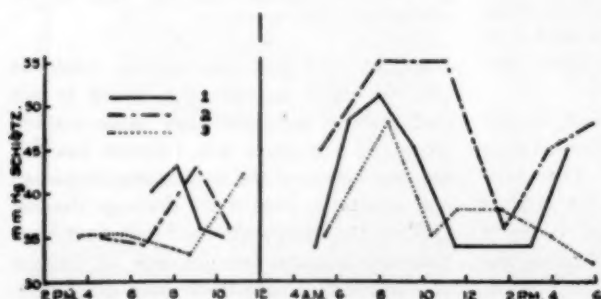


Fig. 10 (Duke-Elder). *Simple glaucoma.* Pre- and postoperative curves. Curve 1 indicates the diurnal tension in February, 1950. Curve 2, the curve in November, 1950, three months after a trephining operation which had become blocked with prolapsed ciliary processes. The oscillations are seen to be greater. Curve 3, in March, 1951, three months after a second trephining operation in which successful drainage seemed clinically to have been attained.

room test (fig. 11); and a similar rise can, although less regularly, be obtained with the instillation of cocaine (fig. 12). Such an episodic attack is usually associated with the appearance of halos and a transient mistiness of vision, but the eye remains white and the patient frequently neglects it.

This phase may last for years; occasionally, however, an acute congestive attack may suddenly develop which the patient cannot fail to remark; and it is of importance that an iridectomy undertaken for the relief of such an attack may control the disease permanently even though physiologic and gonioscopic tests show that no permanent artificial channels of drainage have been established.

A second stage is reached when unusual events are not required to excite such a variation in tension, and a regular phasic rhythm sets in wherein, if no treatment is given, the tension may rise regularly and periodically every day to heights sometimes of 60 or 80 mm. Hg (Schiotz), the patient meantime often suffering no inconvenience except regularly occurring and transient halos. The illustrations of these cases are taken from observations at our Institute by S. J. H. Miller.⁹

In contradistinction to the behavior of the phasic variations in simple glaucoma, which on the whole tend to reach their peak in the morning and to fall steadily in the late evening, the rise of tension in the congestive variety is habitually greatest in the evening, and during sleep the tension almost invariably falls to normal or sometimes subnormal levels (fig. 13). One indeed finds patients who for considerable periods experience these attacks and obtain relief, quite often almost immediate relief, by retiring for a little time to rest, even when they occur during the day (fig. 14).

Fig. 12 (Duke-Elder). *Congestive glaucoma*. An untreated case with narrow angle, subjected to mydriasis with one drop of cocaine HCl (two percent) instilled at 11:40 a.m. Upper line, R.E.; lower line, L.E.

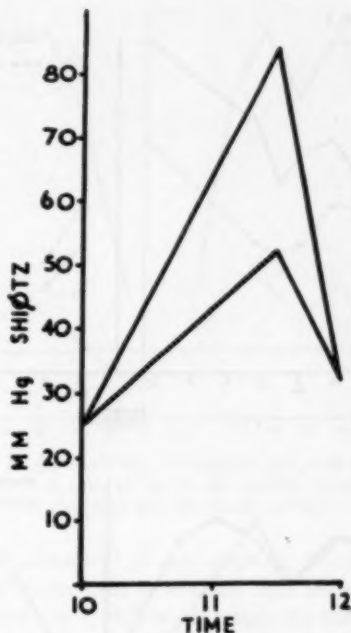
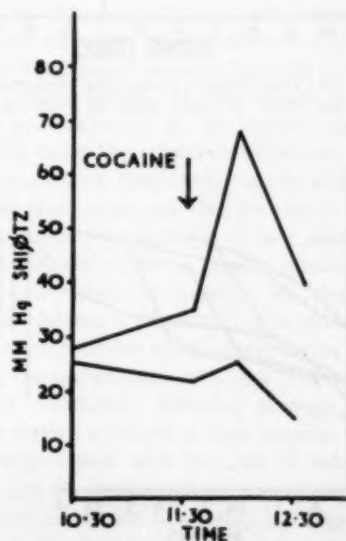


Fig. 11 (Duke-Elder). *Congestive glaucoma*. An early case of narrow-angled congestive glaucoma with intermittent attacks of halos; hitherto untreated. The reaction to the dark-room test. Dark adaptation was maintained between 10 and 11:30 a.m. Upper line, R.E., lower line, L.E.



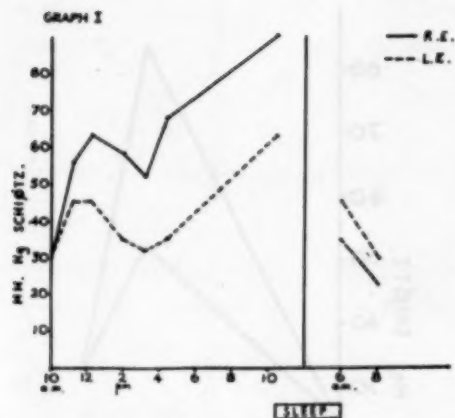


Fig. 13 (Duke-Elder). *Congestive glaucoma*. The diurnal variation showing the tendency of the tension to rise progressively late in the evening and to fall during sleep.

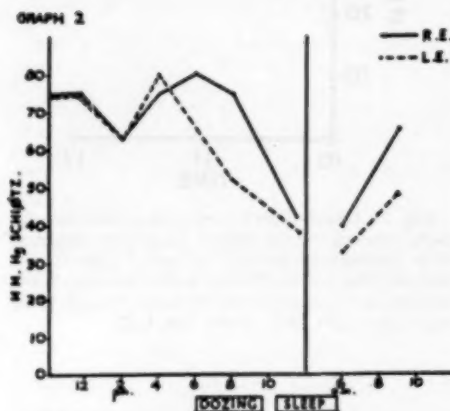
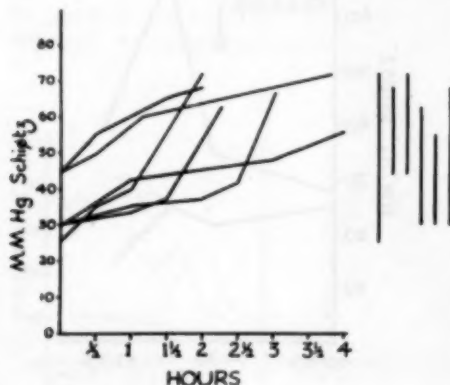


Fig. 14 (Duke-Elder). *Congestive glaucoma*. To show the effect of light sleep in reducing the tension.



At this stage the phasic rhythm of tension is usually controlled within adequate limits by miotics: and this state of affairs may last for years. The optic discs remain pink and show no sign of cupping and the fields, both peripheral and central, are unimpaired so that no disability—beyond the use of miotics—is experienced by the patient nor does objective harm affect the eyes.

It is interesting, however, that after treatment with miotics has been begun, a failure in the natural control seems to be reached much more rapidly. A patient, for example, may survive apparently unscathed in the second stage of phasic variation for a long time without treatment; miotics are then given which control the phasic excursions, but if the miotic is subsequently withdrawn, the tension frequently tends to run up to dangerous heights, and, unless it is rapidly controlled, the tragedy of an acute congestive attack may supervene (fig. 15). It is as if the exhibition of these drugs over a period lessened the natural resiliency of the compensatory power of the eye so that while the margin of safety in their presence may be large over an indefinite period of years, their withdrawal proves to be disastrous.

The final stage is reached when miotics, even an anticholinesterase as effective as DFP, and perhaps the more powerful ganglion-blocking agents as hexamethonium or dibenamine, are without hypotensive effect,

Fig. 15 (Duke-Elder). *Congestive glaucomas*. Six cases of established congestive glaucoma which were on miotic treatment (pilocarpine twice a day). The miotic was withdrawn 24 hours previous to the commencement of the test. A steady rise in ocular tension occurred until a level was reached when it was considered desirable to instill miotics again. The vertical lines indicate the range of variation of the ocular tension.

the tension rises to dangerous levels and remains so, visual symptoms become sufficiently clamant to demand attention, and an acute strangulating circulatory crisis supervenes unless it is forestalled by surgery.

SECONDARY GLAUCOMA

I do not propose to discuss the question of secondary glaucoma here; but, in passing, Figure 16 may be of interest to show that dramatic variations of a similar nature may occur in this type of the disease.

THE CAUSE OF THE VARIATIONS

These, then, are clinical facts. In themselves they are interesting and important; but it is much more exciting to explore the possibility that they may provide some pointers which may help to clarify the enigma of the cause of primary glaucoma. Let us see to what extent this can be done.

The fundamental question to be answered is: What is the cause of these variations? It seems a natural assumption that they have one fundamental cause in both the simple and congestive types of the disease although, as we have seen, the marked differences as, for example, in periodicity, would suggest that in the two conditions this basic cause operates in different ways. To account for the rhythmic variations in tension three theoretical factors at once present themselves: A periodic variation in the formation of the intraocular fluid, a variation in the ease of its drainage, or a disturbance in the vascular circulation. With regard to the first possibility, if we assume—as I think is generally agreed—that the intraocular fluid is formed by a secretory mechanism superimposed upon a process of diffusion, the rise in pressure could be due either to a periodic increase in secretory activity, or, alternatively to increased diffusion owing to an increased permeability of the ocular capillaries.

SECRETORY CHANGES

The answer to the first question is provided by experiments carried out by Langley

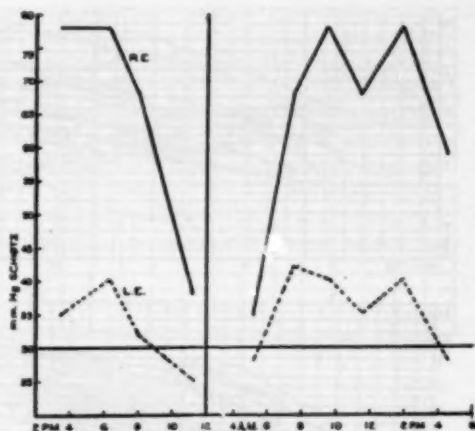


Fig. 16 (Duke-Elder). Secondary glaucoma. Occurring in a case of low-grade cyclitis clinically apparent in the right eye but not in the left.

and MacDonald¹⁰ at our institute. We find that if fluorescein is instilled into the conjunctival sac it diffuses through the cornea and appears in the aqueous humor in a concentration sufficient to be measured optically with considerable accuracy and then slowly disappears. Its concentration and disappearance in the normal eye follow a fairly regular time-curve lasting some 18 hours.

We find that in glaucoma, if the tension is rising or high, the concentration of fluorescein in the aqueous remains high for a very much longer period. If the tension falls, either spontaneously in its normal phasic variation or on the exhibition of miotics, the concentration of fluorescein rapidly falls.

If we were to assume that the rise in tension is due to oversecretion of new aqueous humor—which, of course, would contain no fluorescein—while the drainage facilities remained constant, a dilution of fluorescein in the anterior chamber would result during this phase; the maintenance of a high concentration of fluorescein diffusing through the cornea during a period of high tension, and its disappearance with the fall of tension prove that the increase of tension is not due to excessive secretion of aqueous but suggests that it is due to a blockage of drainage, the

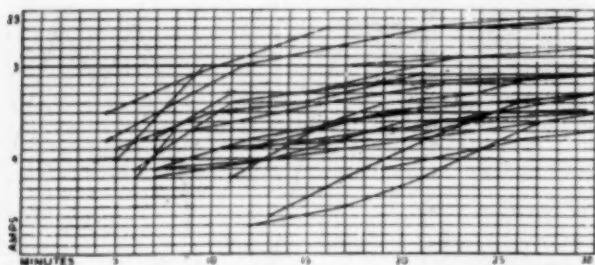


Fig. 17 (Duke-Elder). *Simple glaucoma*. The capillary permeability in the eye measured by the intravenous fluorescein test while the intraocular pressure is in a rising phase. In this and the subsequent four figures, the dotted band represents the normal variation.

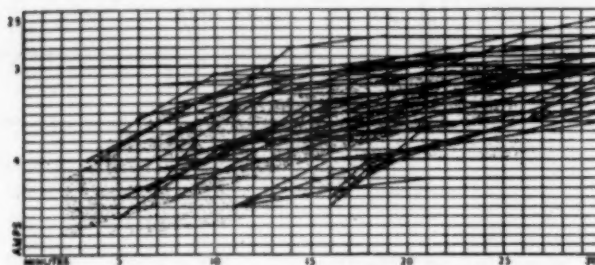


Fig. 18 (Duke-Elder). *Simple glaucoma*. The capillary permeability in the eye measured by the intravenous fluorescein test while the intraocular pressure is in a falling phase.

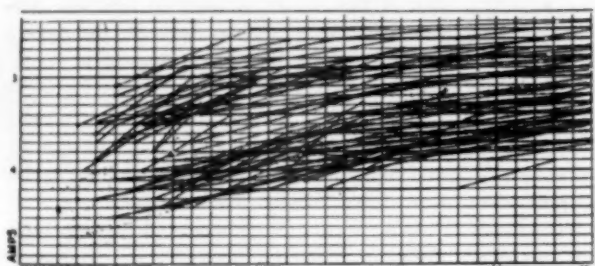


Fig. 19 (Duke-Elder). *Congestive glaucoma*. The capillary permeability in the eye measured by the intravenous fluorescein test while the intraocular pressure is in a rising phase.

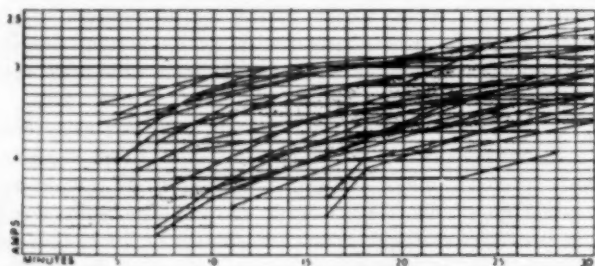


Fig. 20 (Duke-Elder). *Congestive glaucoma*. The capillary permeability in the eye measured by the intravenous fluorescein test while the intraocular pressure is in a falling phase.

relief of which accompanies the fall in tension.

PERMEABILITY CHANGES

Let us turn now to the second question, that of increased capillary dilatation and

permeability. We have shown, and sufficient work has been undertaken by others¹¹ to make the matter fairly certain, that if fluorescein is injected intravenously, its appearance in the aqueous humor is an indication partly of the rate of blood-flow through the

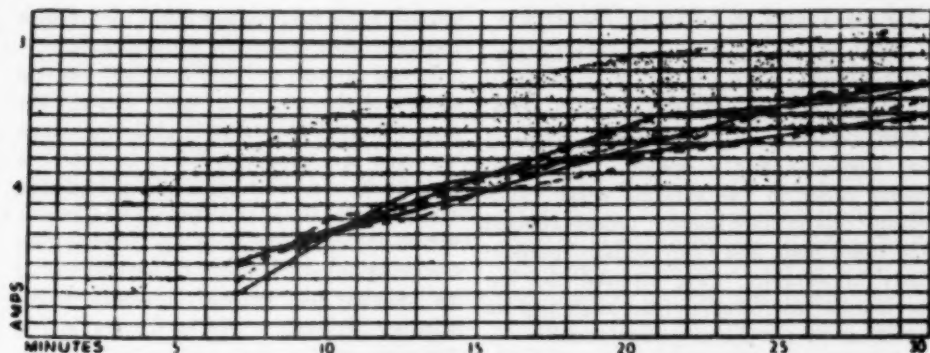


Fig. 21 (Duke-Elder). *Congestive glaucoma*. Three pairs of curves from the same case taken on three different days during a rising and a falling phase of tension and at a time when the level of the tension remained steady.

While it was taken in the rising phase the tension varied: R.E., 32 to 36 mm. Hg (Schiotz); L.E., 30 to 36 mm. Hg (Schiotz). During the level phase of tension (14 days later) the tension in each eye was 28 mm. Hg (Schiotz). While it was taken in the falling phase (14 days later) the tension varied: R.E., 38 to 32 mm. Hg (Schiotz); L.E., 70 to 64 mm. Hg (Schiotz). It is seen that the capillary permeability does not vary significantly, nor does it show any difference between an ocular tension of 28 and of 70 mm. Hg (Schiotz).

capillaries of the eye and partly of the permeability of their walls; owing to the relative impermeability of the ocular capillaries, the mechanism of transference through the blood-aqueous barrier is somewhat different from that in the body generally.

The normal time-variation of the appearance of fluorescein in the anterior chamber as measured optically follows a standard curve. Miller and Swanljung¹² have recorded some 200 observations of this type in glaucomatous patients in our institute.

We have found that, although the general level of permeability is somewhat increased, the phasic variations in tension are associated with no significant alteration in the permeability curves either in the simple (figs. 17 and 18) or congestive (figs. 19 and 20) type of the disease, nor is it related in any way to the height of the ocular tension in a particular case even though it may vary at different times of the day from 30 to 70 mm. Hg (Schiotz) (fig. 21).*

* In a fit of early enthusiasm I published a case (*Recent Advances in Ophthalmology*, 1951, ed. 4, p. 121, fig. 59) showing a decrease of permeability

conclude that increased capillary permeability and increased diffusion do not enter into the causation of the phasic variations.

We now turn to the question of the drainage of the intraocular fluid and we have already received a hint that this matter may well be of importance. Here we are on well-trodden ground and controversies almost a century old begin to rear their heads. The drainage channels comprise the trabeculum at the angle of the anterior chamber, the canal of Schlemm, and the aqueous veins and the other venous exits which drain into the scleral venous plexuses. Drainage difficulties may be encountered at any of these points: at the angle, in the trabeculum, in the canal, in the aqueous veins or, finally, in the efferent venous channels of the deep and superficial scleral plexuses.

in the rising phase and an increase in the falling phase. This was an exceptional and apparently chance early result and shows the impropriety of publishing clinical findings until 200 cases have been studied.

ALTERATIONS IN DRAINAGE CAPACITY

It is a common assumption that the elevation of ocular tension in glaucoma is due to an organic blockage of the drainage channels. Within recent years, for example, Ascher¹³ has suggested that a sclerotic constriction might occur in the aqueous veins, Goldmann¹⁴ that an allied sclerotic process affected the trabeculum, and many authors, particularly in America, have stressed the importance of narrowness of the angle and the presence of peripheral goniosynechias.

It is true that, in the advanced stages of simple glaucoma, changes at the angle may cause embarrassment of the drainage; and it is equally true that, particularly in congestive glaucoma, when the tension rises suddenly to dangerous heights, the associated circulatory disturbance may cause metabolic damage so that an acute congestive condition may arise, conditioned perhaps by the liberation of histaminelike substances, associated with a widespread vascular engorgement, stasis, and edema.

In such a case, a wide angle of the anterior chamber may provide sufficient elasticity to allow the crisis to be tided over while, on the other hand, the spatial constriction of a

narrow angle may readily result in complete blockage with disastrous consequences.

It can be said at once, however, that no structural alterations can easily explain the phasic diurnal variations in glaucoma which we have been studying. There cannot be a structural, sclerotic impediment to drainage which is effective at 12 o'clock and ineffective at two o'clock on the same day. Neither does the cause lie in the width or narrowness of the angle, for similar variations occur whether the angle is wide or narrow, and in the same eye the angle remains of the same width during a rising and a falling phase of tension.

It has been stated that the swing of the tension varies directly with the narrowness of the angle, but this we found not to be the case. Among 66 cases of simple glaucoma examined gonioscopically, of those who showed a phasic variation up to 20 mm. Hg (Schiotz) the proportion of narrow to wide angles was approximately 1:2, while of those whose variations exceeded 30 mm. Hg all had wide angles.

It seems obvious that the block in the drainage must be functional, not structural; and we are accumulating a considerable body of evidence that its immediate cause is a rise in the pressure in the efferent veins. It is clear that the ease and, indeed, the possibility of the outflow of aqueous humor depends on the existence of a drop in pressure along the sequence—anterior chamber, canal of Schlemm, aqueous vein, scleral vein. It is equally clear that, if the pressure in the scleral vein is higher than that in the anterior chamber, no flow can occur.

Measurements which I undertook some years ago¹⁵ showed that the normal state of affairs is as illustrated in Figure 22a wherein the pressure in the episcleral veins is lower than in the anterior chamber so that drainage from the canal of Schlemm can readily occur either through an aqueous vein or by way of the deep scleral veins to the episcleral plexus.

If now the intraocular pressure is raised

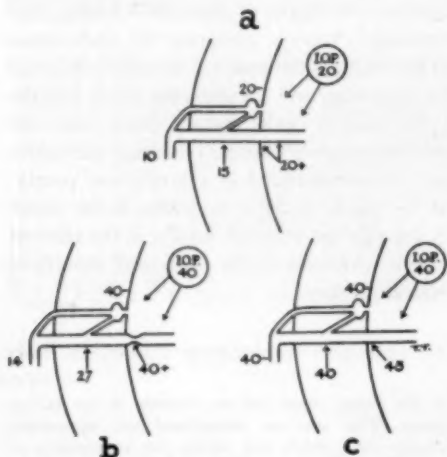


Fig. 22 (Duke-Elder). The relative pressures in the canal of Schlemm and the exit veins.

artificially as through a manometer inserted into the eye, the rise of chamber pressure constricts the circulatory system preferentially at the point of lowest lateral pressure, that is, at the point of exit of the veins (fig. 22b). This will check the flow of blood, and, unless the rise of pressure is so great as entirely to obliterate the vessels, the circulation will proceed at a higher level, the venous pressure as it leaves the eye rising with the intraocular pressure. Between this point and the episcleral plexus there is thus a steep pressure decrement in the vessels traversing the sclera and in these circumstances drainage is maximal.

On the other hand, if the venous pressure is primarily raised the state of affairs is seen in Figure 22c. In this even the pressure in the episcleral plexus remains high and drainage is stopped until the pressure in the aqueous veins and in the anterior chamber is raised passively to a pressure higher than the pressure in the venous exits. There is considerable evidence that this mechanism may account for the phasic variations of the ocular tension in glaucoma.

The most sensitive manometer at our disposal for the clinical measurement of the relative pressures in this region is the observation of the content of the aqueous veins. It is generally agreed that an aqueous vein retains its appearance and character indefinitely; it either contains aqueous or shows a laminated stream. To this rule there is one exception when spontaneous changes may occur; for the aqueous veins in a glaucomatous eye showing phasic variations in tension may show corresponding variations in their content.¹⁸

Figure 23 shows a laminated aqueous vein in such a case when the ocular tension was level; it is seen to contain both blood and aqueous indicating that within it both venous and aqueous pressures are about equal. Figure 24 shows the same aqueous vein in a rising phase of ocular tension; it is full of blood, indicating that during this period the venous pressure is higher than the aqueous

pressure. Figure 25 shows the same vessel after a short interval in a falling phase of tension; it is full of aqueous, indicating that the venous pressure has fallen below the aqueous pressure and that the drainage is free.

Even if this dramatic change does not occur, the width and carrying capacity of the aqueous veins can be seen to change in the two phases, for in the ascending phase they are relatively narrow and during the descending phase of tension they become broader and their carrying capacity of aqueous can be seen to be increased, a fact most easily demonstrated if the aqueous is stained with fluorescein.

The same phenomenon has been verified in our institute in a study of the glass-rod phenomenon¹⁷; when the recipient vessel of an aqueous vein and a blood vein is compressed, a blood influx phenomenon is the usual result in an ascending phase of tension and an aqueous influx in a descending phase. Finally, Thomassen¹⁸ found that in such cases, by tonometric measurements of the ocular tension and measurement of the episcleral venous pressure by compressing these vessels with a transparent pressure chamber, the two pressures varied together but the venous pressure rose higher than the ocular tension in a rising phase and fell below it in a falling phase, the change in venous pressure in each case preceding that in the ocular tension (fig. 26).

PROVOCATIVE TESTS

Artificial changes in pressure experimentally produced confirm this relationship. Such experimental variations are usually known as provocative tests. The most readily performed is the *bulbar pressure test*. Experimentally in an animal, it is found that, if pressure is applied to the globe and then suddenly released, the tension is at first low owing to the fact that some aqueous humor is expelled during the time that the eye is compressed; thereafter it rises rapidly to its starting point if the pressure applied has

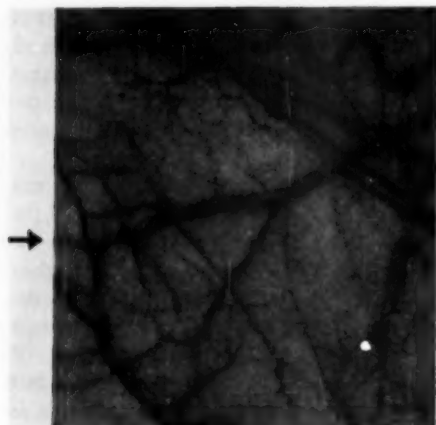


Fig. 23

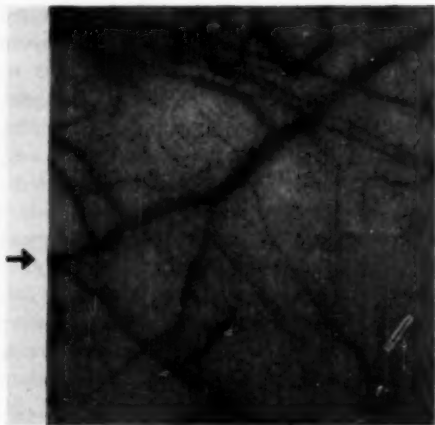


Fig. 24

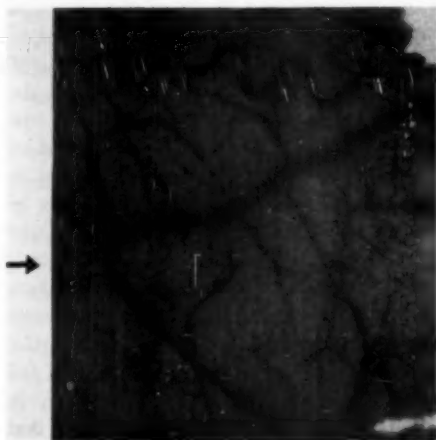


Fig. 25

Figs. 23, 24, and 25 (Duke-Elder). Spontaneous variations in the content of an aqueous vein in a case of congestive glaucoma, photographed at different phases in the ocular tension. The aqueous vein is indicated by the arrow.

Figure 23 shows the aqueous vein with a laminated content during a phase when the tension was level. Figure 24, with a blood content during a phase of rising ocular tension. Figure 25, with an aqueous content during a falling phase.

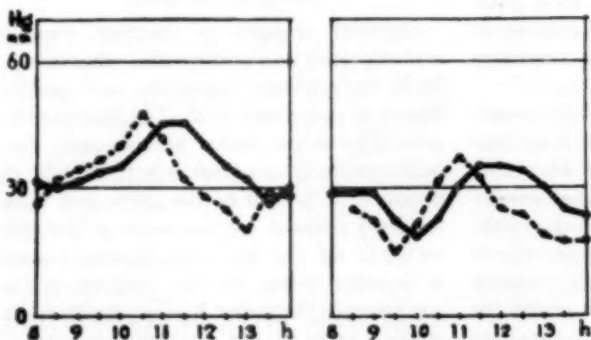


Fig. 26 (Duke-Elder). *Simple glaucoma*. The oscillations in tension during one day from two different eyes suffering from simple glaucoma. The full line in the ocular tension, the dotted line the tension in the episcleral veins. The ordinates indicate the intraocular pressure, the abscissae the time in hours (T. L. Thomassen).

been slight; if, however, the pressure applied has been great, so great as to occlude the circulation for a considerable time, the ocular tension rises above its normal level in a phase of reactive hyperemia and thereafter falls slowly to its normal level after undergoing one or two minor oscillations.

The same phenomena occur in the normal human eye: thus it is found that if a normal eye is subjected to the pressure of a weight of 25 gm. for two minutes, the ocular tension is low at the moment the weight is removed but rapidly rises to the normal height which is never exceeded; even if a pressure of 150 gm., which interrupts the circulation in the eye, is used, a reactive phase of hypertension does not normally occur provided the period of occlusion is as short as two minutes. On the other hand, with greater pressures acting over a longer time, a reactive rise in tension is the rule.

These results suggest that the ocular circulation can normally compensate completely for the derangement caused by a moderate amount of pressure applied to the globe, but finds difficulty in doing so after the circulation of blood has been seriously disturbed over a considerable period.

If we apply this method to glaucomatous eyes interesting results emerge. In an ascending phase of the ocular tension, pressures of the lower order (that is of 25 gm. applied for two minutes) may show quite an abnormal reaction; there may be little or no initial hypotensive effect on the recordings of ocular tension, and the compression may sometimes be followed by a pronounced reactive rise. Pressures of the higher order (150 gm. for two minutes) may produce a negligible fall in tension but excite a reactive rise much more commonly (fig. 27).

The first deviation from normal behavior (the absence of the normal fall in tension) would seem to indicate that expression of aqueous through the drainage channels is difficult and the second (the presence of the reactive rise in tension) that the capillary circulation has lost some controlling mecha-

nism so that a reactive hyperemia occurs with a stimulus that is normally ineffective, the behavior of the eye resembling the reaction of a normal eye to a gross and noxious stimulus.

On the other hand, if the eye is compressed during a decreasing phase of tension, the reaction is normal; the ocular tension falls on compression, the outflow of aqueous into the aqueous veins is visibly increased, and no reactive hypertension occurs thereafter. In this phase, the potentialities of drainage have been restored and the vascular circulation has recovered its poise and can compensate the stresses to which it has been exposed.

The *venous pressure test* is a further trick which may be used to subject the ocular circulation to artificial strains. In this test when the veins in the neck are compressed by the cuff of a sphygmomanometer, the rise of venous pressure thus induced has little effect on the intraocular pressure of the normal eye. In glaucomatous eyes, however, Thomassen and Leydhecker,¹⁰ working in our institute, have found that, if the test is applied during the ascending phase of ten-

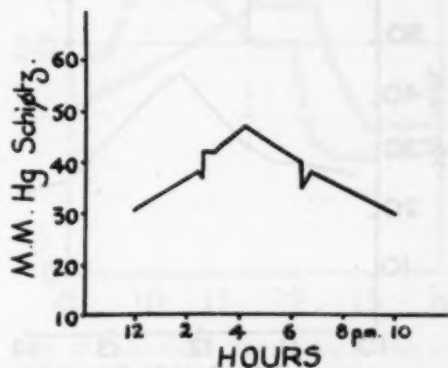


Fig. 27 (Duke-Elder). The bulbar pressure test in a case of simple glaucoma, undertaken during the ascending and descending phases of the ocular tension. In the first case, there is a small initial fall associated with a reactive rise—an abnormal response. In the second case, there is a greater initial fall without a reactive rise, a change characteristic of normal eyes.

sion, a considerable rise of ocular tension follows venous congestion; if it is applied during the descending phase, this does not occur (fig. 28).

The difference in response according to the phasic variation of the ocular tension accounts for some of the divergence of views in the literature as to the value of this test; but this behavior again indicates that, in the rising phase of tension, the ocular circulation lacks some compensatory control which is normally present and which recovers itself in the falling phase.

It is further of considerable interest that over a series of 168 tests Leydhecker²⁰ has shown that the effectivity of the water-drinking test, which depends on the osmotic condition of the blood and not on the dynamic state of the capillaries, is unaffected by the rhythm of the ocular tension but is positive with equal frequency in the ascending or descending phase.

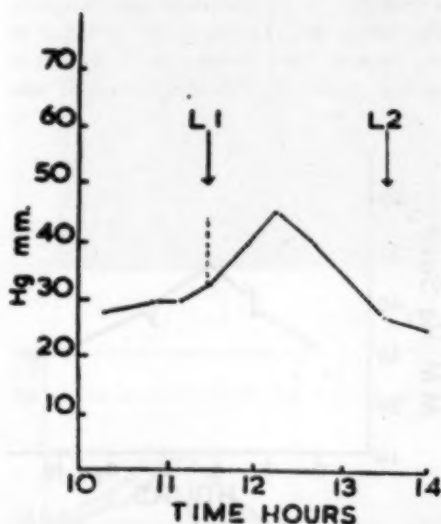


Fig. 28 (Duke-Elder). The response to the venous pressure test in simple glaucoma. L-1 and L-2 indicate the times of application of the test and the dotted vertical line beneath the arrow shows the response of a rise in tension induced by the test during the ascending phase of tension. During the descending phase, no reactive rise was provoked.

ACTION OF DRUGS

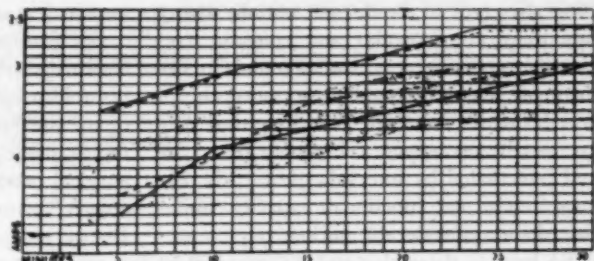
At this point it is interesting to note the hypotensive action of cholinergic drugs. These drugs have two effects upon the eye—they bring about a constriction of the pupil and exert an effect upon the circulation, the most readily evident manifestation of which is the establishment of a capillary dilatation and the opening out of new capillary districts which for the time being may be functionally closed.

In the classical view, these drugs lower the tension of the eye by contracting the pupil and thus opening the angle of the anterior chamber. To some extent and in some cases this may be true, particularly in cases where the angle is narrow and temporarily embarrassed in an acute congestive attack. But this does not explain their effectivity in the more numerous cases wherein the angle is demonstrably open, when it is organically closed by complete peripheral goniosynechias, when the sphincter of the iris is thrown out of action by a coloboma or in cases of aniridia.

On the other hand, we have made many observations which demonstrate clearly their effects on the circulation. Thus after the exhibition of these drugs, the fluorescein test shows a marked increase in the permeability of the ocular capillaries (fig. 29), measurements show a fall in the venous pressure in the exit veins which precedes the fall in ocular tension (fig. 30), and observations of the aqueous veins show an acceleration of drainage due not to the relief of a proximal obstruction within the eye but to a relative fall in the pressure of the recipient veins.

The aqueous veins are dilated and their current accelerated; in the episcleral vessels there is sometimes a complete reversal of flow, for a vessel which before the instillation of the drug seemed to be a blood vein, after its instillation becomes an obvious aqueous vein, and, when the glass-rod test is applied, an aqueous-influx phenomenon can be observed in many vessels where before it could not. When these events occur at a time

Fig. 29 (Duke-Elder). *Simple glaucoma*. The permeability of the capillaries as indicated by the fluorescein test. The lower curves indicate the permeability in each eye before, and the upper curves after the instillation of pilocarpine (one percent). The dotted area represents the normal range of permeability.



when the tension in the anterior chamber and therefore in the aqueous veins is falling, they must be interpreted in terms of a relatively greater fall in the venous circulation.

It would seem, therefore, that these drugs can minimize the phasic variations in tension and lower pathologic rises of tension in glaucoma by dilating the ocular capillaries, opening up the capillary circulation, and lowering the pressure in the exit veins.

GLAUCOMA: A VASCULAR DISEASE

We therefore arrive at the conclusion that the exaggerated rhythm of the ocular tension seen in glaucoma is due to lack of the local vascular control which normally keeps variations of tension within comparatively strict limits. This instability is manifested in a rising phase of tension by an increase in the hydrostatic capillary-venous pressure. This in itself will raise the tension of the eye; but in addition, the consequential rise of pressure in the exit veins into which the aqueous veins flow, embarrasses or may even abolish the drainage of the intraocular fluid. After a successful drainage operation, the second factor is eliminated for the aqueous can flow into the subconjunctival space instead of into the high-pressure veins; in such an event the phasic variations which persist are presumably due directly to changes in the hydrostatic capillary pressure.

In the earlier stages of the disease, and sometimes for a very long period, this instability is phasic, transient, and recoverable; circulatory control periodically re-asserts itself, capillary-venous pressure falls, drain-

age is restored, and the ocular tension declines.

In the simple type of the disease these variations are regular, spontaneous but slowly and remorselessly progressive, and presumably eventually cause organic changes of a degenerative nature in the eye. In the

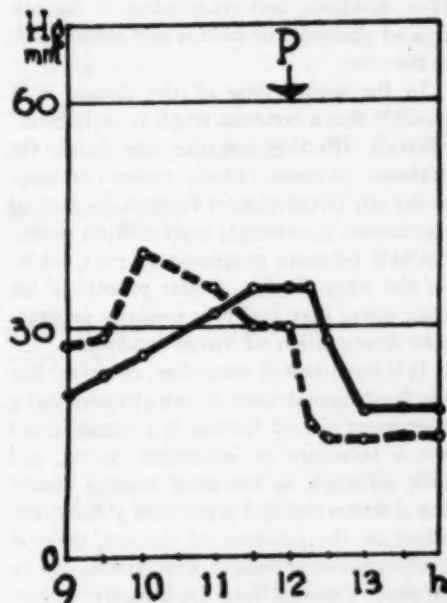


Fig. 30 (Duke-Elder). The hypotensive effect of pilocarpine. The curves represent the ocular tension during one day in an eye suffering from simple glaucoma. The full line indicates the ocular tension, the dotted line the tension in the episcleral veins. The abscissae represent hours. At P, pilocarpine was instilled into the conjunctival sac; the venous pressure fell abruptly, the fall being followed by a similar decline in the ocular tension (T. L. Thomassen).

congestive type of the disease, initially at any rate, they are irregular and episodic, frequently requiring a special stimulus to fire them off, and they tend to be more abrupt and dramatic; but since for a long time they are usually occasional, completely reversible and punctuated by intervals of rest, the eye may retain its functional capacity unimpaired for a considerable period.

So long as these changes are intermittent and the circulation returns periodically to normal, so long as the eye gets periodic rest-periods, its function may survive. But if these changes pass from the functional to the organic, from the reversible to the irreversible stage when compensation becomes difficult, infrequent, and eventually impossible, permanent damage results. This may be slow, insidious, and remorseless in the one type of glaucoma or sudden and catastrophic in the other.

In the simple type of the disease it is possible that a common result is an ischemic sclerosis affecting, on the one hand, the drainage channels which makes drainage under any circumstances through the normal mechanism increasingly more difficult so that the base pressure progressively rises, while, on the other hand, a similar process in the optic nerve may lead to a similarly progressive deterioration of visual function.

It is important to remember, however, that the fundamental cause is vascular and that a permanent rise of tension is a common, but not a necessary or invariable, sequel, and that, although an increased tension always has a deleterious and sometimes a disastrous effect on the function of the eye, there is every reason to believe that vision can be affected, although less dramatically, by degenerative changes caused by the vascular

impairment in the absence of tension.

For a time these permanent changes may be warded off by diminishing the circulatory instability by cholinergic drugs, or the rises of pressure may be neutralized by substituting drainage through an artificial channel by surgical procedures into the subconjunctival tissues instead of the high-pressure veins. But in either case the evidence at our disposal suggests that none of the methods of therapeutics available to us is more than palliative, for none of them attacks the fundamental cause. It is for this reason that the prognosis in glaucoma, particularly when sclerotic changes are far advanced, is bad.

The nature of this fundamental cause is, of course, the most intriguing question. So far we have spoken only of its peripheral manifestations and suggested a mechanism through which it may act. But the nature of the underlying factor is yet unknown. At the present time we are engaged in trying to elucidate it. It seems clear that it is neurogenic in nature, but so far we are in a position to make only intelligent guesses. These, however, will not take us very far. The literature abounds in speculations which have little practical value, for they violate the logical sequence: look first, think later.

The only sure way by which we can travel with any hope of reaching our goal is by the intensive study of hundreds of cases over many years, by the slow and somewhat tedious but, nevertheless, fascinating process of painstaking clinical observation, checked and correlated with controlled experiments both in the clinic and in the laboratory. So, at this point, if I am to be logical, I finish this lecture and return home to do more work.

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HYDROSULPHOSOL AS A TREATMENT OF CHEMICAL BURNS OF THE EYE

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INTRODUCTION

A new sulfhydryl yielding solution, hydrosulphosol (E. C. Lientz Company), has been on the market since 1942. This solution has been sold since that time under the claim that it is a less expensive vehicle for furnishing the SH radical.

The SH radical itself has been known for many years¹ as an adjuvant to epithelial cell proliferation.² The use of this chemical was not popular in the late 1920s and early 1930s due to the high cost of the then available product, and, more important, to the fact that

the epithelial response was not sufficiently rugged to withstand ordinary stress and strain.

The SH radical was apparently unused as a medical aid until 1942 when a study of the then new hydrosulphosol was undertaken by Mellon.³ The principal research in this study pertained to the use of the chemical on burns of the skin, but mention is made of the action of the material when applied to chemical burns of the eye.

Mellon concluded that the benefit derived from the SH radical is due to the nutritional

value of glutathione, the normal cellular content of this material being reinforced by application of the artificial chemical. It is noted in this study that the chemical must be materially diluted for use in the eye because of the burning reaction of the concentrated material.

Cruthirds⁴ reports 43 cases of eye burns from different chemicals "with uniformly satisfactory results." During the past two or three years Kuhn⁵ has also advocated the use of hydrosulphosol for treatment of chemical burns of the eye.

There has also been an intensive advertising campaign, both by mail and by mention in several instruction courses at the Academy of Ophthalmology and Otolaryngology.

Hydrosulphosol, as a new treatment for chemical burns, was suggested by Dr. Kuhn for use in my practice a few years ago and was used on a short series of cases. My results at that time were inconclusive and use of the material was discontinued due to the fact that I was getting satisfactory results with my denuding technique.⁶ I was not, at that time, able to improve those results with this preparation which added considerably to the difficulty of administering an effective treatment for chemical burns.

Hydrosulphosol has been changed since then so that now it is delivered by the manufacturer in small bottles containing an amount of the concentrate already in partial suspension in castor oil. The major part of the concentrate floats in an oily mass suspended in the larger amount of castor oil. To attain a reasonably satisfactory general suspension the entire bottle must be heated somewhat warmer than body temperature and shaken actively. Application is then made to the conjunctival sac by means of a dropper.

REACTIONS TO HYDROSULPHOSOL

The application of hydrosulphosol to the eye produces a marked burning sensation in the absence of topical anesthesia and a fairly

marked burning under pontocaine. Complete freedom from pain is obtained with cocaine anesthesia.

There is much variation in the degree of pain experienced and this variation is explained by the normal variation of pain-threshold as it exists in individual patients. One patient in my series experienced such intense pain that he refused to receive any further application of hydrosulphosol. A report of a definite allergy has been recorded in recent literature.⁷

Substantial confirmation of these reactions was made by members of my instruction class at the 1950 meeting of the Academy of Ophthalmology and Otolaryngology. The opinions of the men who discussed this chemical varied from inconclusive to definite disapproval.

The chemical action of hydrosulphosol with the large group of chemicals produced in the manufacturing chemical industry was discussed on an unofficial basis with several qualified chemists. It was the consensus that no one chemical such as hydrosulphosol could, under the laws of chemistry, be expected to neutralize any and all chemicals that might, by accident, be present in the human eye.

On an unofficial basis, a number of chemicals were subjected to test-tube reactions with the material and found to be unchanged or only altered, chemically, to a slight degree. It was also noted that the presence of the oily suspension would retard any reaction and that the chemical structure of the oil itself might enter the reaction.

CLINICAL STUDY

A clinical study problem was set up so that hydrosulphosol could be observed as a treatment for chemical burns of the eye which occurred in my day-to-day contacts with such cases as they originate from the various chemical plants in this area. Each case treated with hydrosulphosol was paired with a similar case treated by my denuding technique.⁸ The only selection of individuals was made

on the basis of the offending chemical, the first case of any one chemical being treated by hydrosulphosol and the second case treated by the unmodified denuding technique.

The following chemicals were included: Di-ethyl sulphate, aluminum chloride, carbon disulfide, acetic acid (concentrated), phosphorus oxy-chloride, di-butyl ether, aluminum phosphate, di-butyl tin, sodium sulfide, iso-propyl sulfate, vinyl chloride, acetic anhydride, ethyl hexanol (2), 50-percent sodium hydroxide, lime (2), maleic anhydride, battery acid (sulfuric), seven cases of unknown chemical (an injury very common in industrial chemistry).

CRITERIA

A series of 52 cases were observed; 26 cases were treated with hydrosulphosol and 26 like cases treated with the unmodified denuding technique. The following criteria were used in making the observations in this clinical study:

1. Standard packages of hydrosulphosol were purchased on the open market for use in this study.

2. No cases were treated with hydrosulphosol alone, since adequate evidence of neutralizing power is not available. Each case was denuded with slitlamp control as in the denuding technique.

3. Pain was noted in all applications of hydrosulphosol and compared with pain in control case.

4. Rapidity of healing was noted.

5. Residual opacities were noted.

6. Quality of new epithelium was studied.

7. Hydrosulphosol was used alone except for necessary topical anesthetics for relief of after-pain.

8. Resistance to secondary infection was noted.

9. Eyes burned with identical chemicals were observed in the treated and control cases. Unknowns cannot be identical but are classed as a common injury and therefore are identical.

OBSERVATIONS

1. The vehicle in which hydrosulphosol is sold is unsatisfactory because it must be warmed and shaken. This poses a technical difficulty which could be overcome by the use of a stable solution.

2. Due to the fact that this was a clinical study, experimentation with hydrosulphosol as a neutralizing agent could not be risked.

3. There was no predictable pattern of pain on primary application and secondary application. It was also noted that there was no predictable pattern of pain under the denuding technique. The pain seemed to vary as the pain-threshold varies between individuals. One patient experienced such severe pain with the hydrosulphosol on the first application that he refused any further use of the medication. In one large plant news of the "new treatment" spread, and toward the end of the study frequent requests were made to omit the new medication.

4. There was no notable increase in the rapidity of healing in the cases treated with hydrosulphosol. There was the usual variation in the time required for epithelization which may be explained by the normal variation of physiologic characteristics in individuals.

5. Residual opacities were present in a few cases after each type of treatment. Hydrosulphosol did not seem to prevent these. No opacities were permanent and no vision was lost in any case.

6. The new epithelium was found to be perfectly stable in all cases.

7. It was necessary to use pain-relieving drugs as frequently with hydrosulphosol as without.

8. Secondary infection was noted in two cases in the hydrosulphosol series. One was explained on the basis of dental infection and was relieved by the extraction of the offending teeth and the topical application of cortisone. The other case was explained on the basis of a severe common cold. This was un-

usual as I have never had this complication in a long series of cases treated with the denuding technique and antibiotics.

9. Identical chemical burns were comparable only to the extent that identical chemicals were involved. The quantity of a chemical present in the eye, the promptness of first-aid washing, and the degree of burn were uncontrollable factors. Burns caused by an unknown chemical, or chemicals, are common accidents in the chemical industry. Seven of these cases are included in this study to demonstrate the difficulty of applying specific therapy in the form of a single drug.

SUMMARY

A completely unbiased study was made of hydrosulphosol as it is recommended for the treatment of chemical burns of the human eye. It was determined that the material may be used without serious danger in the human eye, but that it cannot, by the laws of chemistry, be expected to neutralize each and every chemical.

From this study it was determined that even the healing power claimed for glutathione may be questioned when it is supplied by hydrosulphosol. The presence of castor oil in the preparation seems to be a deterrent factor in the contact of the active chemical with the living tissue of the eye.

CONCLUSION

It is concluded that hydrosulphosol is only another treatment for chemical burns of the eye. It apparently is not superior to the denuding technique* and is actually a questionable preparation since it encourages a false sense of security brought about by the misquoted claims that harmful chemicals are neutralized. If the material is used for the glutathione effect, antibiotics should be used also for their antiseptic effect. Improvement in the vehicle would certainly make the use of the material much more acceptable from a technical standpoint and for simplicity of use.

805 Atlas Building (1).

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OPHTHALMIC MINIATURE

All animals that have hairs on the body have lashes on the eyelids; but birds and animals with scalelike plates, being hairless have none. Of hairy animals, man alone has lashes on both lids.

Aristotle, *Parts of Animals*, Book II, Chap. 14, circa 345 B.C.
From the translation by W. Ogle, M.D.

THE LABILITY TEST AND GONIOSCOPY IN THE DIAGNOSIS OF GLAUCOMA*

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Interest in the provocative tests in the diagnosis of glaucoma has been recently stimulated by the publications of Bloomfield and Lambert.¹ These investigators, in 1945, described a new procedure for the diagnosis of chronic simple glaucoma—the lability test. This consisted of a combination of measured jugular compression as described by Schoenberg and the cold-pressor test of Hines and Brown—both applied simultaneously.

A rise of intraocular pressure to over 30 mm. Hg (Schiotz) was found in 31 out of 34 unoperated eyes with known chronic simple glaucoma, when these eyes were temporarily in the normal tension range and not under the influence of miotics; in only one of 77 presumably nonglaucomatous eyes did the tension exceed the 30 mm. Hg level. The upper limit of normal was consequently considered to be 30 mm. Hg; however, a rise in ocular tension of more than 9 mm. Hg (Schiotz) was also considered abnormal, though not conclusively so.

Using this test, Sykowski,² in 1948, found 100-percent positive results in 31 patients with chronic simple glaucoma. Stine,³ in 1948, found a rise to over 30 mm. Hg in 31 of 35 eyes with wide-angle glaucoma classified gonioscopically; whereas, in 35 normal eyes the test was negative. On the other hand, Sugar⁴ found a high percentage of false-positive and false-negative results. Also Kronfeld⁵ stated that his experiences with the lability test had been discouraging and that as high as 77-percent false-positive results had been found in a series of 24 normal individuals.

The difficulty of assessing the reliability of this test from the published reports

prompted the present study. The specific aim was to evaluate the efficiency of the lability test in separating out eyes with glaucoma, previously undiagnosed and unsuspected, from normal eyes.

MATERIAL

Two hundred white male subjects were examined. They presented themselves at an out-patient clinic with complaints not directly related to the eyes and with no history of serious eye disease. The selection was by chance. The ages of these persons ranged from 20 to 85 years. One hundred persons were under 50 years of age, 100 were over 50. The average age of the younger group was 29.3 years, that of the older 59.8.

METHODS

All patients were examined by the lability test, gonioscopy, ophthalmoscopy, and the slitlamp. Visual fields were taken as indicated. All findings were recorded on prepared forms.

The lability test was invariably performed first. In this test the patient rests for 15 minutes in a quiet room during which time a basin of water to which ice cubes have been added becomes ice cold. The patient is then seated in a reclining treatment chair or assumes the supine position on a treatment table.

The angle of the patient's head and trunk is then adjusted to about 10 to 15 degrees from the horizontal. In this position the tip of the mastoid process of the temporal bone is about six cm. above the level of the right auricle of the heart. The latter is considered to be at a point 10 cm. from the skin of the patient's back when the supine position is utilized.⁶ The 10- to 15-degree position minimizes the effect of gravity on the pressure within the head veins and also serves as a

* Read before the New England Ophthalmological Society, March, 1950.



Fig. 1 (Ross). Technique of gonioscopic examination. The corneal microscope, from which the high-power objective has been removed, is held in the hand with the elbow supported on a rest raised to the level of the patient's head. The light, held in the other hand, supplies a slitbeam which plays over the field of observation.

known level which can be referred to in comparative studies.

The nature and procedure of the test are carefully explained to the patient. He is instructed to breathe easily and regularly during the test and not to strain or talk. In some cases the nasal mucus membranes become congested during the procedure making nose breathing somewhat difficult. The patient is told that, if this occurs, he is to breathe through his mouth.

A blood-pressure cuff, folded once upon itself, is secured about the neck with the bladder portion anterior. The tension of each eye is taken. The patient then places one open hand up to the wrist in ice water while simultaneously the blood-pressure cuff is inflated to a pressure of 55 to 58 mm. Hg. At the end of one minute, the intraocular pressure is again taken with the hand still in ice water and the cervical pressure undiminished. The hand is then taken out of the water, the cuff removed and the test is over.

The test may be repeated in 10 minutes if results are questionable; the second read-

ings in these cases are more reliable than the first.

Following this test gonioscopy is performed as follows (fig. 1): With the patient in the same position a Troncoso goniolens⁷ is inserted. The light used is the National Electric Instrument Company "specialist" headlight⁸ with some minor adjustments. This gives a very adequate slitbeam when the condensing lens is moved forward with the help of an adaptor.

Microscopy is performed with the corneal microscope portion of the slitlamp apparatus, detached and held in the hand, with the observer's arm steadied by resting the elbow on a stool or table raised to the same height as the patient's head. The observer moves around different quadrants of the patient's head, while the patient aids with appropriate movements of his eyes.

Very adequate clinical gonioscopy can be carried out in this fashion, and is materially aided if the observer looks at the angle first with a six- to eight-power loupe. Previous tension determinations do not materially affect the procedure.

RESULTS

In the group examined, the average tension rise with the lability test in normal eyes was 5.5 mm. Hg. However, several of these eyes, without any evidence of glaucoma whatsoever, showed a rise of 9 to 11 mm. Hg. Consequently, a rise of nine mm. was dropped from consideration as a reliable indication of glaucoma. Attention was directed entirely to whether or not the 30 mm. Hg mark was exceeded.

In both eyes of each of 196 patients the tension did not reach the 30 mm. Hg mark; this was considered a negative result. In both eyes of one patient the tension rose to reach exactly the 30 mm. Hg mark; this was considered to be a questionable result. In both eyes of each of the three remaining patients the tension rose definitely to over 30 mm. Hg; this was considered a positive result.

Of the 392 eyes with negative response

none showed any evidence of glaucoma by history, high initial tension, fundus examination, or visual-field examination in questionable cases. The patient with the tension rise to just 30 mm. Hg showed no evidence of glaucoma; his chamber angles showed considerable deposition of brownish-black pigment upon the trabeculum. Such a result would be considered questionable and the patient would be considered as one to be kept under observation.

The following gonioscopic observations are of interest in the eyes of the over-50 age group with negative results to the test.

In 12 percent, the chamber angles were considered excessively narrow. This figure is somewhat lower than that of Bangerter and Goldmann⁶ who found that in 19 percent of normal eyes the angle was narrow or invisible.

In only seven percent of the over-50 age group was the angle found to be heavily pigmented; however, in all these cases at least one fifth of the chamber angle was clear or but moderately pigmented in some portion of its circumference. The percentage of these heavily pigmented angles was equally distributed between eyes with blue irises and those with brown—in contradistinction to the impression⁶ that the amount of pigment in the trabeculum varies with the complexion.

The absence of any relationship between the pigment of the iris stroma and angle pigment seems logical when we consider that the latter pigment is derived not from the iris stroma but from the posterior pigment layer of the iris and the pigment layer of the ciliary body.

Among the group of 392 eyes with negative results to the lability test was one case of unilateral exfoliation of the anterior capsule of the lens. This was in the left eye of a man, aged 62 years. The trabeculum of that eye showed quite heavy brown pigmentation throughout most of its circumference; however, no shreds of lens capsule were present in the angle. The right eye was perfectly normal in all respects, and its angle

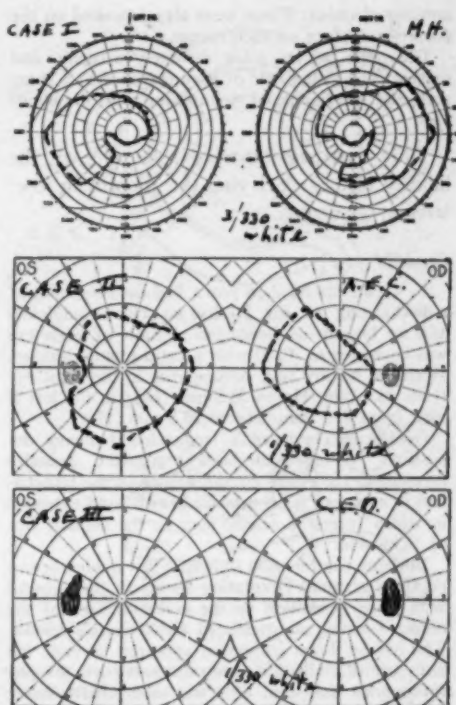


Fig. 2 (Ross). Visual fields of the three patients, out of the group of 200 surveyed, who gave positive results with the lability test.

showed no pigment. No symptoms or signs of glaucoma were present in either eye.

CASE REPORTS

Among the total group of 200 patients who were examined, three (fig. 2) gave a positive response to the lability test.

CASE 1

M. H., a man, aged 63 years, had presenting complaints referable to the cardiovascular system. Vision of the right eye was 20/20; vision of the left, 20/50 not improved with glasses. With the lability test, tension rose in the right eye from 23.0 mm. Hg to 37.5 mm. Hg; in the left it rose from 21.5 mm. Hg to 37.5 mm. Hg.

Gonioscopy showed the chamber angles to be definitely open. Brownish-black pigment granules were quite heavily distributed over the entire circumference of the trabeculum of each eye.

Slitlamp examination revealed many golden-brown pigment granules slowly circulating in each

anterior chamber. These were also deposited on the posterior surface of each cornea.

The optic nerves were definitely atrophic and cupped. The visual field of each eye showed a characteristic inferior nasal step uniting with the blind spot.

This case demonstrated the aid of the lability test in clarifying the picture in low-tension glaucoma.

CASE 2

A. C., a man, aged 38 years, had the complaint of a discharging left ear. He had no ocular complaints and no history of headaches. Vision of each eye was corrected to 20/20 with a small minus cylinder. With the lability test, tension rose in the right eye from 26.7 mm. Hg to 38.5 mm. Hg; in the left it rose from 27.7 mm. Hg to 38.5 mm. Hg.

Gonioscopy revealed a tremendously heavy deposition of chocolate-brown pigment granules throughout the entire circumference of the trabeculum of each eye. This massive brown band extended in width from the scleral spur to the annular line of Schwalbe.

Slitlamp examination showed a few golden-brown pigment granules circulating slowly in the aqueous with some deposition on the posterior face of the cornea forming an attenuated Krukenberg's spindle. The iris on direct inspection appeared normal; but with transillumination, quite extensive iris atrophy throughout was seen. This was undoubtedly due to atrophy of the pigment layer of the iris. The nerveheads were quite normal in appearance.

Visual fields showed considerable restriction of the 1/330 isopter with baring of the blindspot, bilaterally. With the use of pilocarpine (0.5 percent) the tension bilaterally dropped to 21 mm. Hg. About three months after the original examination the patient reappeared and stated he had stopped the use of drops. Tension at that time was: R.E., 32.0 mm. Hg; L.E., 30.3 mm. Hg.

Comment. Pigment deposition in the chamber angle as a cause of glaucoma has been debated for many years. Koeppe¹⁰ and Barkan¹¹ have been the outstanding advocates of this theory. The consensus at the present time is that pigment deposition is not a major etiologic factor in glaucoma.

Massive pigment deposition, however, is quite another thing. Troncoso⁷ stated in his recent book on gonioscopy that a large amount of pigment widely distributed throughout the chamber angle could materially impede the aqueous outflow.

Two cases similar to the one just described have recently been reported by Sugar

and Barbour.¹² Their patients were men, aged 29 and 33 years, respectively. The clinical picture consisted of dense trabecular pigment rings as seen with the gonioscope, Krukenberg spindles, intraocular pressure of from 30 to 40 mm. Hg (Schiotz), normal discs, early field change in one case, and good pressure drop with pilocarpine. Sugar^{12a} stated that these were the only two such cases he had seen in several thousand gonioscopies.*

CASE 3

C. D., a man, aged 41 years, had symptoms of anxiety and at times drank heavily. On further questioning he gave a history of frequent, extremely severe frontal headaches, associated with pressure sensation in the eyes, of five years' duration.

Vision of the right eye was 20/20 with +1.50D. sph. \ominus +1.75D. cyl. ax. 87°. Vision of the left eye was 20/80 with +4.25D. cyl. ax. 104°.

The lability test caused the tension in the right eye to rise from 25.6 mm. Hg to 40 mm. Hg; in the left, from 24.6 mm. Hg to 41 mm. Hg.

Gonioscopy showed the corneoscleral portion of the chamber angle in each eye to be entirely covered with thick, interwoven irislike tissue, quite obscuring the entire circumference of the trabeculum. The ciliary border of the iris took off at a normal wide angle from the site where the ciliary body is normally seen; but it was only by transillumination that the shadow of this structure could be made out through the heavy tissue covering it. The optic discs showed no abnormality.

Visual fields showed moderate enlargement of the blindspots. On prostigmine (2.5 percent) twice daily the tension dropped to 17 mm. Hg in each eye and the headaches disappeared.

Comments. The upper age limit of juvenile glaucoma has been placed by some writers at 20 years, by others at 30, and by still others at 40.¹³ With the increasing use of gonioscopy, it is becoming evident that many cases of juvenile glaucoma may have the same main etiologic factor as that which causes most congenital glaucoma; namely, congenital remnants of pectinate ligament blocking the chamber angle.

Ellis¹⁴ has recently reported five similar cases of juvenile glaucoma. In these cases the most striking symptom was frequent severe headache occurring over a period of several years. Gonioscopy showed dense tissue

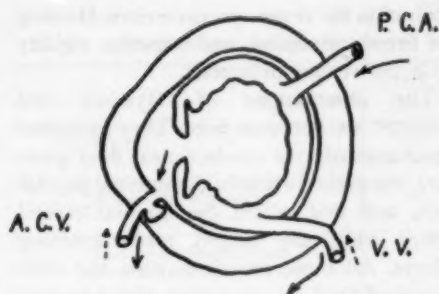


Fig. 3



Fig. 4

Figs. 3 and 4 (Ross). Diagrams of the normal and abnormal physiology, respectively, of the lability test. The arterial inflow into the eye (PCA) is derived from the internal carotid artery (ICA). Both the aqueous outflow (ACV) and the venous outflow (VV) from the eye drain ultimately into the internal jugular vein (IJV). Placing the hand in ice water at the beginning of the test causes a pressor effect on the blood pressure, compensating for the depressor effect of the carotid sinus reflex which may be initiated by cervical pressure. Jugular compression, by blocking both venous and aqueous outflow from the eye, raises the intraocular pressure normally (fig. 3). When a pathologic block to aqueous outflow (fig. 4) is present, the rise in pressure is higher than that in the normal eye.

blocking all or a large part of the chamber angle.

The intraocular pressure was intermittently elevated; it was often, however, in the normal range. The optic discs were normal except in one case. Visual fields varied; some showed early changes characteristic of glaucoma, others were normal. The ages of the patients varied from 15 to 26 years. Treatment was by goniotomy in three cases and by prostigmine alone in two.

DISCUSSION

PHYSIOLOGY OF THE LABILITY TEST

Normal (fig. 3). The inflated sphygmomanometer cuff presses upon the carotid sinus¹⁸ in the neck thereby reflexly initiating a fall in blood pressure. This tendency is

overcome by the pressor effect of simultaneously placing the hand in ice water. The net result is a slight increase in blood pressure which maintains a flow of blood into the eye at least equal to that before the beginning of the test.

Compression of the jugulars partially blocks the venous return from the head and thereby increases the pressure within the veins of the head including, of course, those of the eye, since the orbital veins have no valves. Venous return from the choroid is via the vortex veins into, ultimately, the internal jugulars.

Aqueous outflow is via the canal of Schlemm and the aqueous, episcleral, conjunctival, and ciliary vein plexuses, also ultimately into the internal jugulars. The pres-

sure within these two venous systems increases with jugular compression. The intraocular pressure must consequently also rise, as Duke-Elder¹⁰ stated. It rises to the height at which the rate of flow of aqueous into the canal of Schlemm is such that a level of equilibrium is again maintained.

Abnormal (fig. 4). The vortex veins traverse the sclera at an extremely oblique angle through canals four to five mm. in length. Duke-Elder¹⁰ stated that, when the chamber pressure is raised the intraocular circulatory system is compressed. The veins, since they have the lowest lateral pressure within the intraocular circulatory system, become compressed—at their oblique points of exit. Arterial blood from behind piles up. The intraocular venous pressure rises and the intraocular chamber pressure rises with it.

In the normal eye, any chamber pressure rise over that prevailing in the canal of Schlemm and its tributaries causes an increased aqueous outflow. When the flow of aqueous into the canal of Schlemm is obstructed, however, the intraocular pressure must continue to rise. This further compresses the intraocular veins at their points of exit. In this way a cumulative pressure rise occurs, until aqueous is finally forced past the obstruction in the canal at such a rate of flow as is sufficient to maintain a level of pressure equilibrium: one which is, however, higher than that in the normal eye.

FALSE POSITIVE REACTIONS TO THE LABILITY TEST

A. We have seen that in this test the intraocular chamber pressure varies directly with that of the intraocular venous pressure. This latter, in the absence of abnormalities, is directly influenced by the pressure prevailing in the head and neck.

It is well known in general physiology that the respiratory movements of the chest profoundly influence venous pressure. In inspiration the venous pressure is lowered by the sucking action within the thorax; in

expiration the venous pressure rises. Holding the breath, straining, and muscular rigidity raise the venous pressure.⁶

The observations of Myerson and Lomax¹⁷ are pertinent here. They measured simultaneously the cerebrospinal fluid pressure, the pressure within the internal jugular vein, and that within the internal carotid artery while the subject made straining efforts. All three pressures rose, the cerebrospinal fluid pressure often rising to high levels—over 300 mm. of water.

During the performance of the lability test, there is a strong reflex tendency for the subject to hold his breath and strain against the restriction around his neck. When this occurs, the intraocular pressure in a perfectly normal eye may frequently rise above 30 mm. Hg. This can be prevented by the very simple procedure of having the patient breathe deeply and regularly, through the mouth if necessary.

B. Another source of presumably false-positive results to the lability test is variation among tonometers. In the series of cases reported here, a new certified tonometer was used, which may be identified as tonometer No. 1. A second certified tonometer, No. 2, purchased from the same maker, gave several false-positive results to the lability test in normal eyes.

When placed upon the footplate supplied with tonometer No. 1, the pointer of tonometer No. 2 deviated from the zero mark, counter clockwise, one tonometer scale unit. On normal eyes and in eyes with moderately elevated tension it also gave readings of one tonometer scale unit higher than No. 1.

Kronfeld⁸ stated that, among certified tonometers as manufactured today, a deviation of ± 3.0 mm. Hg in the normal tension range is the greatest thought to be present. The difference of one tonometer scale unit between the two tonometers just mentioned is only 2.0 mm. Hg in the normal pressure range.

However, around the 30-mm. Hg range, one tonometer scale unit is now equivalent

TABLE 1
PLACE OF DIAGNOSTIC TESTING AND GONIOSCOPY IN THE DIAGNOSIS OF GLAUCOMA

	Lability Test	Mydriasis Test	Gonioscopy
Normal	—	—	Confirms in some cases, what can only be inferred by tests
I Wide-angle glaucoma	+	—	Permits separation of angles with excessive narrowing from others
II Narrow-angle glaucoma (In remission angle not blocked)	—	+	Reveals: Extensive pigment deposition in angle Congenital tissue blocking angle Peripheral anterior synechias blocking angle
III A. Narrow-angle glaucoma with extensive periph. anter. synech. B. Late wide-angle glaucoma with extensive periph. anter. synech. C. Mixed glaucoma	+	+	

to 4.0-mm. Hg pressure. On the same eye, a reading of 28.7 mm. Hg by tonometer No. 1 is equivalent to 32.7 mm. Hg on tonometer No. 2; that is, using the lability test, a negative result with No. 1 and a positive with No. 2. Obviously one must know exactly the amount, if any, of the deviation of his tonometer from the standard Schiötz.

PLACE OF PROVOCATIVE TESTS AND
GONIOSCOPY IN DIAGNOSIS OF
GLAUCOMA (table 1)

Stine,³ in his excellent paper, has emphasized that eyes with narrow-angle glaucoma, and with temporarily normal tension, give a *negative* result to the lability test. This would naturally be expected; for when the angle is no longer blocked by the iris, the eye behaves with the test in the same manner as does a normal eye.

However, as Kronfeld⁵ pointed out, for the narrow-angle group there is available another test, one which is safe and quite reliable—the dark-room test. Moreover, as several investigators¹⁸ have shown, mydriasis does not generally cause a significant tension rise in eyes with wide-angle glaucoma.

We have available, therefore, two different provocative tests, each one of which is specifically applicable to one of the two great groups of primary glaucoma and not to the

other. Of course, when anterior peripheral synechias develop (and in wide-angle glaucoma these occur very late in the course of the disease) both tests may be expected to be positive.

Also, rare cases of mixed glaucoma occur; these may be expected to give positive results with both tests.

The main function of gonioscopy in diagnostic glaucoma procedures is to reveal eyes with excessively narrow angles. In addition, at times totally unexpected, abnormalities in the angle may be seen. Also, anterior peripheral synechias are disclosed by this method.

No test, or even group of tests, is necessarily individually diagnostic¹⁹ of a disease; it must be interpreted in the light of the whole clinical picture. However, when employed in addition to careful history, ophthalmoscopy, search for visual field defects, and repeated tonometry, provocative testing and gonioscopy are of great value in the diagnosis of glaucoma.

SUMMARY

The lability test was found to be reliable in separating out six eyes with wide-angle glaucoma, previously undiagnosed and unsuspected, from among 400 normal eyes.

Gonioscopy gave additional information

and clarified the diagnosis in two cases: one of pigmentary glaucoma and one of juvenile glaucoma.

Excessively narrow chamber angles were found in 12 percent of normal eyes of persons over 50 years of age. None of these eyes gave an abnormal response to the lability test.

No true false-positive response to the lability test was found after patients' involuntary straining movements were eliminated,

and after correction had been made for variation among even certified tonometers.

Heavy pigment deposition occurred in only seven percent of the chamber angles of nonglaucomatous eyes of persons over the age of 50 years.

No correlation was found between iris color and amount of pigment granule deposition in the chamber angle.

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VISUAL PERFORMANCE AND FATIGUE UNDER CONDITIONS OF VARIED ILLUMINATION*

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SYNOPSIS

The effects of varied intensity and spectral composition of mixed white light were studied using a specially designed work test, a series of tests of visual functions measured before and after two hours of work, and a discomfort questionnaire administered at the completion of each testing session.

The visual work involved recognition of small, moving details, briefly exposed to the view, and thus represented a schematic miniature of industrial inspection of objects transported on a conveyor.

The design of the main series of experiments involved three factors—intensity of illumination (three levels), spectral quality of illumination (three illuminants), and subjects (six)—with replication of each experimental condition.

The results were analyzed in terms of a complex analysis of variance, yielding sensitive tests of the statistical significance of the differences between the mean scores obtained under different conditions of illumination. In addition, a biologic evaluation of the relative importance of the differences between the experimental conditions was attempted. It consisted in expressing the differences as percentages of the maximum difference (difference between the best and worst score for a given function).

The stress conditions used to establish the limits of deterioration involved strenuous visual work carried on for two hours at two foot-candles and for four hours at five foot-candles, and were close to the limit of tolerance.

INTRODUCTION

The mechanical engineer has succeeded, to

a remarkable degree, in eliminating heavy muscular work from modern manufacturing industry. Through the use of a variety of devices, such as subdivision of the operations and use of machine tools, the number of jobs demanding a high level of the worker's manual skill and versatility were markedly reduced.

On the other hand, the number of operations involving sustained visual work has increased. In particular, visual inspection of on-going processes and of finished goods has become a critical point in a large number of jobs.

Consequently, the study of the relationships between illumination, its quantity and quality, and visual performance is one of the pressing research tasks of industrial hygiene, shared with the art and science of illuminating engineering.

Strangely enough, the amount of dependable information on illumination and sustained visual performance is grossly disproportionate to the need for such information. It can hardly be denied that, in studies on illumination and performance as well as in basic sciences, generalizations of known dependability can be obtained only by methods of controlled observation, involving the use of experimental and statistical analysis.¹⁰ Yet the fact remains that such observations are scarce.

American investigators concerned with industrial illumination have shied away from studies of performance. This was because of several reasons, some valid and indicative of the difficulties involved, some irrelevant and accidental.

As a rule, rigorous experimental investigations on illumination and performance under actual working conditions are not feasible. Performance always represents a product of work capacity and motivation.

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In industry, motivation is a complex resultant of uncontrolled sociopsychologic factors. The well-known phenomenon of "stereotyped output" illustrates convincingly that industrial performance is frequently determined by social pressures rather than by the physiologic limits of performance.

A rational solution of the dilemma is to study the relationship between illumination and output under laboratory conditions using miniature work situations in which the performance task reproduces the essential features of an industrial operation.⁸ The study of single visual functions, tested before and after work, can be combined advantageously with the investigation of the integral of functions measured as output.

Weston, a British investigator who devoted much attention to the study of illumination and performance, expressed as follows his belief that a scientific basis for lighting practice can be obtained only by means of laboratory investigations: "Experimental studies, made by taking jobs—or their visual equivalents—into the laboratory, where the fortuitous circumstances and the multiplicity of variables which so often complicate the issue in 'field' investigation can more easily be avoided, offer the best hope of elucidating the relationship between visual efficiency and the primary features of work-sights."¹²

The principle of miniature work situations was applied at this laboratory to the experimental study of factors affecting visual performance and fatigue involved in inspecting objects transported on a conveyor.⁸ Six illumination levels were studied (2, 5, 15, 50, 100, and 300 foot-candles on the screen). At 5, 100, and 300 foot-candles, three commercially available illuminants, emitting mixed "white" light of different spectral distribution, were compared. In one experimental series at five foot-candles, the duration of the work task was extended from two to four hours.

Some of the results were described in

previous publications.^{9,13,14} The present paper is concerned with an over-all comparison of the experimental conditions, with emphasis on the main experimental series (three illuminants at three levels of illumination).

In the earlier papers, the evaluation of the differences between experimental conditions was based primarily on considerations of the statistical significance; unless differences between mean values obtained under different experimental conditions reach or exceed the accepted level of statistical significance, they are to be interpreted, until further evidence is obtained, as due to chance variation. The conditions were compared in pairs (two levels of illumination; two illuminants).

The effects of the level of illumination were considered without taking into account the possible superimposed effect of the different illuminants. This is a tolerable but not a satisfactory simplification and leads to difficulties in the proper statistical evaluation of the differences between the experimental conditions. In the present paper the data are submitted to statistical analysis taking into account the complex factorial structure of the experimental design.

Important as the criterion of statistical significance is, it does not provide information about biologic importance of the observed differences. Under certain conditions even a very small difference can be statistically highly significant and yet be biologically unimportant.

In the present paper, a new biologic evaluation of the observed differences was attempted which consists in expressing the difference in the performance level and in the deterioration of visual functions as percentages of the range of differences between the mean scores representing the pessimum and optimum, respectively.

WORK TASK

The work test, developed for studies of visual performance and fatigue,⁸ consisted in

the recognition of small details (letters of a size corresponding to a visual angle of 10 minutes, which at the low levels of illumination was only slightly above the threshold value). The letters were mounted on a long belt, transported by wooden drums, and were passing at irregular intervals and at irregular levels through a narrow slit in front of the subject who had to copy the letters, without looking down. The copying of letters under conditions used in these studies did not require any appreciable manual skill. The head was kept by a support at a constant distance from the slit. The subjects were seated in individual booths.

The work performance was characterized quantitatively on the basis of six-minute work samples of 200 letters. The score represents the number of letters (out of 200) which were copied correctly. Continuous work records were kept for the whole work period. For purposes of analysis of the work records six-minute samples, obtained at the start of the work and at the end of the first and second hour of work, were used.

The work task was severe and was designed to produce definite visual fatigue within two hours. The visual strain probably equalled, if not exceeded, the strain imposed by a working day of eight hours in jobs involving strenuous visual work (category A of the Illuminating Engineering Society illumination code).

In work tasks exceeding a duration of two hours, nonvisual fatigue processes are likely to interfere with performance. Such interference could not be entirely eliminated even in the two-hour experiments. It could be objected that, by reducing the length of the work period, the results lose some of their practical applicability. However, we were primarily interested in visual fatigue, and tried, therefore, to eliminate all nonvisual sources of interference as far as possible. Moreover, we were interested in general and fundamental problems of visual fatigue rather than in recommendations of any spe-

cific illumination level or other environmental variable.

Of course, a practical application of our results and comparison with the jobs listed in the illumination codes is of interest. Since our work task was a "miniature work situation," developed in a laboratory, it is not exactly comparable to any of the jobs listed in the illumination code of the Illuminating Engineering Society.

The task, involving recognition of details, had some similarity with proofreading but it was much harder since the letters were moving, could appear at any height of the slit, and their exposure time was limited to a fraction of a second. This point has been overlooked in some discussions of our results.¹¹

In preliminary experiments, the speed of movement was set at such a level that, at a good illumination, the number of errors (letters missed or incorrectly read) would be about 10 percent. This goal was attained, with the average scores (number of letters correctly transcribed out of 200) of 188.3, 189.3, and 188.0 at 50, 100, and 300 foot-candles, respectively.

This seemed to be a good criterion for the relative severity of the task. It was impossible to make the work task much harder and still maintain the semblance of a real work situation.

The absolute severity of the task could be further increased by reducing the degree of contrast or increasing the speed of movement of the letters. If the same relative severity should be retained, decrease of the contrast between the letters and the background or increase in speed would have to be compensated by an increase in the letter size.

This does not mean that a similar performance level, attained under different conditions of contrast, illumination level, object size, and so forth, would necessarily indicate a similar degree of visual strain. This is most probably not the case; on the contrary, a different strain pattern is more likely. Only

the study of changes in visual functions could provide a definite answer to this intriguing problem. However, no such information is yet available. The level of performance seems to be, at the present time, the best available method of roughly equating the relative severity of a task under different experimental conditions.

TESTS OF VISUAL FUNCTIONS

In addition to the evaluation of visual performance (average level, performance decrement from the beginning to the end of the work period) numerous tests were applied before and after the visual work, each of the four testing units taking up approximately five minutes of testing time:

1. Recognition time for threshold-size dots and flicker fusion frequency (F.F.F.).

2. Ophthalmologic tests (abduction, adduction, vertical divergence, accommodation near point, convergence near point).

3. Ophthalmograph (eye movements).

4. Brightness discrimination.

Thus, the total testing time was about 20 minutes. In addition, the blinking rate was measured at the beginning, in the middle, and at the end of the work period. Only those tests the results of which are utilized in this paper will be briefly described. The effects of practice and the consistency of measurements

repeated under standard conditions have been discussed elsewhere.^{6,7}

The subjective aspects of fatigue were recorded after the work by means of a discomfort questionnaire. This questionnaire was developed on the basis of observations made in preliminary work-test trials, commented upon in writing by the subjects and followed by interviews.

Each of the 10 items, such as "smarting of the eyes," was rated on a scale from 0 to 4 (0 = no change, normal, phenomenon absent; 1 = more, 2 = much more, 3 = very much more, 4 = extreme). In making the ratings the subjects were requested to compare their condition at the end of the work period with their state at the start of the day's session. The sum of the ratings was used as the score.

Eye movements were studied using an ophthalmograph.² A record of the eye movements was obtained by means of a beam of light, reflected from the cornea of the eye on a moving film. For 10 seconds the subject had to move the eyes back and forth between two points, separated by a visual angle of about 15 degrees. The successive horizontal sweeps of the eyes were to follow each other at the maximum speed of which the subject was capable.

Limiting the analysis to one eye, the per-

TABLE 1
FUNCTIONS MEASURED, THEIR UNITS, AND THE BIOLOGICALLY POSITIVE ("DESIRABLE")
DIRECTION OF THE SCORES

Functions	Units	"Desirable" Values
DURING WORK		
Average performance	No. of correct letters (Based on 3 samples of 200 letters)	Higher
Performance decrement	No. of letters (Difference between initial and terminal score)	Lower
Average blinking rate	Blinks per minute (Average based on 3 determinations)	Lower
BEFORE AND AFTER WORK		
Recognition time	Seconds	Lower
Flicker fusion frequency	Rate of flickers per sec. at the fusion level	Higher
Rate of voluntary eye movements	No. of movement-fixation cycles per sec.	Higher
AFTER WORK		
Discomfort questionnaire	Sum of complaint ratings	Lower

formance can be evaluated in terms of a number of quantitative criteria. Here only the rate of movements will be considered; it was defined as the number of movement-fixation cycles per second.

The blinking frequency during five-minute periods was obtained by visual observation; the blinking rate per minute was used as a score. The recognition time for stimuli (dots) of threshold size was determined by means of a stop-watch. The flicker fusion frequency was determined by means of conventional methods,⁴ with the beam of light being interrupted by an interposed rotating disc.

The functions considered in the present paper are summarized in Table 1.

The results of the tests made before and after the work period may depend, in part, on their sequence in the testing battery. The same test sequence was retained throughout.

SUBJECTS AND CONDITIONS

Six healthy young men in their twenties with normal vision served as subjects. They were coöperative and willing to do their best even under adverse conditions. Their daily routine and living conditions were well known, and any major interference (emotional, work load, nutrition, disease) during the experimental period could be excluded. The experiments were performed in an air-conditioned room, at a comfortable temperature and humidity.

Three levels of illumination were used in the main series—5, 100, and 300 foot-candles. The level of illumination refers to the foot-candles at the plane of the slit through which the letters were viewed. The brightness of the visual field was fairly uniform within about one foot on each side of the slit. The letters were printed in black on good white paper. The same paper was used to line the front part of the individual booths.

The three illuminants—verd-a-ray, ordinary inside frosted lamps, and natural white, designated as I_1 , I_2 , and I_3 , respectively—

were described in detail.¹⁴ All three illuminants emit mixed white light, with a slightly green tinge in the case of I_1 and slightly blue tinge in illuminant I_3 . The color differences were small and could be clearly recognized only when the lamps were viewed simultaneously.

In terms of utilizable radiant energy at different wave lengths, the curves of all three illuminants were displaced somewhat toward higher wavelengths as compared with the curve indicating the light sensitivity of the human retina. This displacement was least marked in illuminant I_1 , most marked in illuminant I_3 .

Taking the ordinary frosted lamp (I_2) as reference point, the I_3 lamps emit slightly more light below 5,700 A.U. and somewhat less light above 5,800 A.U. The I_1 lamps emit less light at both ends of the visible spectrum and somewhat more light between 5,000 and 5,500 A.U. This comparison refers to an equal level of illumination, since the experiments were made under this condition.

The existing differences in light output of the three illuminants were compensated by means of screens with multiple perforations placed in front of the lamps, and by slight variation of the distance between lamps and the screen. The lamps were mounted in metal boxes and shielded from the subjects; only one technician but neither the subjects nor the experimenters knew which lamp was used by any subject on any particular day.

The data were decoded only after the experiments were finished, and the statistical evaluation was made by associates who had not taken part in the tests. These precautions were considered necessary in order to obtain complete objectivity.

STATISTICAL SIGNIFICANCE OF THE DIFFERENCES BETWEEN EXPERIMENTAL CONDITIONS

Classically, experimenters in biology—following the lead of the older experimental sciences of physics and chemistry—have considered as their "model" the single-factor

experiments; that is, experiments in which all independent variables but one were to be held constant. We have utilized this model in the earlier communications^{13, 14} in which the effect of one variable, such as the spectral quality of illumination, was considered while the other variables, including the intensity of illumination, were kept constant. The experimental conditions were compared in pairs, two at one time.

Such a procedure yields a large number of detailed results, the synthesis of which is laborious and subjective. The tests of significance are applied to a large number of differences between two series of measurements. It is obvious that some of the elevated *t* or *F* ratios may be interpreted as due to chance alone.

McNemar¹² stressed that a more general test of significance of the differences between all the levels of a factor should precede the tests of significance between any two levels. Thus the importance of the spectral quality of light should be established, as a more general proposition, before evaluating the significance of the difference between any two particular illuminants. Of course, the fact that the sampling of experimental conditions is frequently limited must be considered in the interpretation of the statistical tests of significance.

Strictly speaking, it is rarely possible to hold all but one condition "constant." We

may compare legitimately performance at two levels of illumination intensity only when we use the same illuminant. When we use more than one illuminant and average the results, we are simplifying the matter; we may be averaging data that are not homogeneous. Paired comparisons obscure the possible dependence of one factor (such as the illumination intensity) on the other factor or factors (such as the spectral quality of light).

In the present experiment, the results will be analyzed in the framework of a multiple-factor experimental design. We have three factors (subjects, illuminants, levels of illumination), with replication, as each experiment was repeated. The multiple-factor analysis provides for a breakdown of the variances (mean squares) associated with each factor into their components and, consequently, allows one to make more exact tests of significance of the differences between the mean scores obtained by the subjects at different illuminants and different illumination levels.

Out of the large number of functions and characteristics measured, only those were selected for the multifactor analysis which appeared promising on the basis of earlier analyses. These include average performance in the two-hour inspection test and the decrement in the performance level from the start to the end of the working period; average blinking rate; change in the recognition time for threshold stimuli, in the fusion frequency of flicker, and in the rate of voluntary eye movements; and the discomfort score. The factorial design of the experiment, indicating the sources of variation and the degrees of freedom, associated with the variances, is reproduced in Table 2.

The composition of the variances (mean-squares), V , in terms of their components, σ^2 , is indicated in Table 3. The knowledge of the composition of the variances is useful for three reasons: (1) It facilitates carrying out the tests of significance in a proper sequence;

TABLE 2

FACTORIAL DESIGN OF THE EXPERIMENT

Three factors were present: L, levels of illumination ($L=3$); I, illuminants ($I=3$); S, subjects ($S=6$), with R, replicate determinations ($R=2$)

Source of Variance	Degrees of Freedom
L, Levels of illumination	$L-1=3-1=2$
I, Illuminants	$I-1=3-1=2$
S, Subjects	$S-1=6-1=5$
L×I interaction	$(L-1)(I-1)=4$
L×S interaction	$(L-1)(S-1)=10$
I×S interaction	$(I-1)(S-1)=10$
L×I×S interaction	$(L-1)(I-1)(S-1)=20$
R, Residual (Replicates)	$LIS(R-1)=54$
T, Total	$LISR-1=107$

TABLE 3
COMPOSITION OF THE VARIANCES

$V_L = \sigma_R^2 + R\sigma_{LI}^2 + RS\sigma_{LI}^2 + RI\sigma_{LI}^2 + RSI\sigma_L^2 + RSL\sigma_I^2 + RIL\sigma_S^2$
$V_I = \sigma_R^2 + R\sigma_{LI}^2 + RS\sigma_{LI}^2 + RI\sigma_{LI}^2 + RSL\sigma_I^2 + RIL\sigma_S^2$
$V_S = \sigma_R^2 + R\sigma_{LI}^2 + RS\sigma_{LI}^2 + RI\sigma_{LI}^2 + RSL\sigma_I^2 + RIL\sigma_S^2$
$V_{LI} = \sigma_R^2 + R\sigma_{LI}^2 + RS\sigma_{LI}^2 + RI\sigma_{LI}^2 + RSL\sigma_I^2 + RIL\sigma_S^2$
$V_{LS} = \sigma_R^2 + R\sigma_{LI}^2 + RS\sigma_{LI}^2 + RI\sigma_{LI}^2 + RSL\sigma_I^2 + RIL\sigma_S^2$
$V_{IS} = \sigma_R^2 + R\sigma_{LI}^2 + RS\sigma_{LI}^2 + RI\sigma_{LI}^2 + RSL\sigma_I^2 + RIL\sigma_S^2$
$V_{LIS} = \sigma_R^2 + R\sigma_{LI}^2 + RS\sigma_{LI}^2 + RI\sigma_{LI}^2 + RSL\sigma_I^2 + RIL\sigma_S^2$
$V_R = \sigma_R^2$

(2) it provides a guide for "pooling" error variances which do not significantly differ from each other; (3) it allows estimation of the amount of variability contributed by each source of variation.

There are three principal questions to be answered by statistical analysis: (1) Are the differences between levels of illumination (L) significant? (2) Are the differences between illuminants (I) significant? (3) Are the effects of the level of illumination dependent, in part, on the illuminants?

Technically, we ask: Are the "between levels" (V_L), "between illuminants" (V_I), and "levels \times illuminants interaction"

($V_{L \times I}$) variances significantly different from the appropriate "error" variance?

The significance of a variance, arising from a specific source of variation, is tested by comparing the given variance with the appropriate "error" variance. The variance to be tested should contain only one more component (σ^2) than the error variance.

It is apparent from Table 3, indicating the composition of the variances, that the "error" term for testing the significance of $V_{L \times I}$ is the second-order interaction, $V_{L \times I \times R}$. The numerical values of the variances are given in Table 4.

The interaction variances $V_{L \times I \times R}$ do not

TABLE 4
SUMS OF THE DEVIATIONS SQUARED (Σd^2), DEGREES OF FREEDOM (df), AND THE RESULTING VARIANCES (V, MEAN-SQUARES)

Source of Variance and Degrees of Freedom	Average Performance	Performance Decrement	Av. Blinking Rate	Change in F.F.F.	Change in Recog. Time	Discomfort Score	Change in Rate of Eye Movements
L (2)	Σd^2 10,854 V 5,427.0	950 475.0	289.23 144.6	1.34 0.67	245.17 122.6	10 5.0	0.1455 0.078
I (2)	Σd^2 118 V 59.0	39 19.5	4.23 2.1	45.59 22.80	313.28 156.6	69 34.5	0.0990 0.050
S (5)	Σd^2 7,152 V 1,430.4	6,203 1,240.6	959.91 192.0	16.92 3.38	219.94 44.0	2,749 549.8	1.8732 0.375
LI (4)	Σd^2 256 V 64.0	270 67.5	1.97 0.5	3.21 0.80	20.92 5.2	39 9.8	0.2830 0.071
LS (10)	Σd^2 2,596 V 259.6	565 56.5	271.72 27.2	10.96 1.11	126.52 12.7	179 17.9	2.8761 0.288
IS (10)	Σd^2 172 V 17.2	1,227 122.7	79.52 8.0	18.96 1.90	153.66 15.4	100 10.0	1.4436 0.144
LIS (20)	Σd^2 654 V 32.7	796 39.8	110.88 5.5	19.90 1.00	559.18 28.0	96 4.8	1.2975 0.065
R (54)	Σd^2 1,115 V 20.6	6,964 129.0	249.75 4.6	61.15 1.13	860.25 15.9	475 8.8	15.7411 0.292

TABLE 5
 MEAN VALUES FOR ILLUMINANTS AT DIFFERENT LEVELS OF ILLUMINATION, WITH EACH MEAN BASED ON 12 DETERMINATIONS ($S \times R = 6 \times 2$); GRAND MEANS,
 BASED ON 108 DETERMINATIONS ($S \times R \times L \times I = 6 \times 2 \times 3 \times 3$) AND THE F-TESTS OF STATISTICAL SIGNIFICANCE OF V_{LI} , THE
 "LEVELS \times ILLUMINANTS INTERACTION" VARIANCE

	L_4			L_3			L_2			L_1			Grand Mean	$F = V_{LI}/V_{B_0}$
	I_1	I_2	I_3	I_1	I_2	I_3	I_1	I_2	I_3	I_1	I_2	I_3		
Average performance	171.3	164.8	166.1	189.9	187.8	190.1	186.7	187.8	189.4	181.5	181.5	181.5	64.0 23.9	2.68*
Performance decrement	-13.8	-13.2	-15.2	-6.0	-8.6	-5.8	-14.3	-9.7	-8.6	-10.6	-10.6	-10.6	67.5 104.9	
Average blinking rate	9.6	9.8	9.9	5.7	5.4	6.3	8.4	8.1	8.5	8.0	8.0	8.0	0.5 4.9	
Change in flicker fusion frequency	-0.36	-1.00	-1.42	+0.13	-1.33	-1.52	-0.07	-1.46	-1.93	-0.99	-0.99	-0.99	0.80 1.10	
Change in recognition time	-1.5	-3.5	-6.0	+1.3	-2.3	-2.3	+2.3	-0.9	-1.8	-1.6	-1.6	-1.6	5.2 19.2	
Change in rate of eye movements	-0.19	-0.26	-0.09	-0.19	-0.26	-0.32	-0.19	-0.27	-0.32	-0.23	-0.23	-0.23	0.071 0.230	
Discomfort score	8.1	10.3	7.0	8.0	7.8	7.3	7.2	9.7	7.9	8.1	8.1	8.1	9.8 7.7	

- = "deterioration"; + = "improvement" in the function after two hours of inspection work.

* Significant at the five-percent level; $F_{5,10} = 2.49$, $F_{5,10} = 3.58$.

differ significantly from the residual (replicate) variances, V_R , as the values of the ratios of $V_{L \times I \times R}/V_R$ are below the five-percent level, $F_{0.05} = 1.75$, except for the change in recognition time which just reaches the five-percent level.

Consequently, the two terms, $V_{L \times I \times R}$ and V_R , may be "pooled"; in arriving at the weighted average, the degrees of freedom serve as "weights." This yields a new error term, V_{R1} , with 74 degrees of freedom. The ratios of $V_{L \times I}$ and the pooled error terms, V_{R1} , are given in Table 5.

Only the value for the average work performance, $F = 2.68$, is higher than the five-percent level of significance ($F_{0.05} = 2.49$, $F_{0.01} = 3.58$). This indicates that the illuminants do not retain the same relative "order of excellence." This may be seen on inspecting the mean values in Table 5. The pattern changes from level to level.

Next question to be taken up concerns significance of the differences between illuminants. The "between illuminants" variances

appear, at first, as rather complex terms (see table 3). However, we have seen that the second term, the component σ^2_{LIR} , may be considered as being equal to zero—that is, nonexistent, as the $V_{L \times I \times R}/V_R$ ratio was nonsignificant.

Similarly, the fourth component, σ^2_{IR} , may be neglected, as the ratios of $V_{I \times R}$ to their error term, V_{R1} , are not significant; the third component may be also legitimately omitted as the ratio of $V_{L \times I}$ to its error term is nonsignificant, except for the average performance score (see table 5). In this case the V_I value is to be tested against $V_{L \times I}$; the ratio is 59.0/64.0, obviously not significant.

In all other cases, we may legitimately pool V_R , $V_{L \times I \times R}$, $V_{I \times R}$, and $V_{L \times I}$. This yields the "error" variance V_{R2} , with 88 degrees of freedom.

The F-ratios are given in Table 6. The values for "average performance" are put in parentheses to indicate that the denominator is not a fully valid error term. Only the differences between mean changes in flicker

TABLE 6
MEAN VALUES FOR THREE ILLUMINANTS AND THE F-TESTS OF SIGNIFICANCE OF THE DIFFERENCES
Each mean is based on 36 determinations ($S \times R \times L = 6 \times 2 \times 3$). F-tests are the ratios V_I/V_{R2}

	I_1	I_2	I_3	F
Average performance	182.6	180.1	181.9	$\left(\frac{59.0}{25.0}\right)$
Performance decrement	-11.4	-10.5	-9.9	$\frac{19.5}{105.2}$
Average blinking rate	7.9	7.8	8.2	$\frac{2.1}{5.0}$
Change in flicker fusion frequency	-0.10	-1.26	-1.62	$\frac{22.80}{1.17} = 19.48^\dagger$
Change in recognition time	+0.68	-2.24	-3.36	$\frac{156.6}{18.1} = 8.65^\dagger$
Change in rate of eye movements	-0.19	-0.26	-0.24	$\frac{0.050}{0.213}$
Discomfort score	7.8	9.3	7.4	$\frac{34.5}{8.1} = 4.26^*$

+ = Improvement, - = deterioration after two hours of inspection work.

* = Significant at the five-percent level of significance ($F_{0.05} = 3.10$).

† = Significant at the one-percent level of significance ($F_{0.01} = 4.85$).

TABLE 7
MEAN VALUES FOR THREE LEVELS OF ILLUMINATION AND THE F-TESTS OF THE SIGNIFICANCE
OF THE DIFFERENCES
Each mean is based on 36 determinations ($S \times R \times I = 6 \times 2 \times 3$)

	L_1	L_2	L_3	F
Average performance	167.4	189.3	188.0	$\left(\frac{V_L}{V_{LS}} = \frac{5,427.0}{259.6} = 20.91 \right) \dagger$
Performance decrement	-14.1	-6.8	-10.9	$\frac{V_L}{V_{RS}} = \frac{475.0}{97.7} = 4.86 \dagger$
Average blinking rate	9.8	5.8	8.3	$\frac{V_L}{V_{LS}} = \frac{144.6}{27.2} = 5.32^*$
Change in flicker fusion frequency	-0.93	-0.90	-1.15	$\frac{V_L}{V_{RS}} = \frac{1.34}{1.08}$
Change in recognition time	-3.7	-1.1	-0.1	$\frac{V_L}{V_{RS}} = \frac{122.6}{17.8} = 6.83 \dagger$
Change in rate of eye movements	-0.18	-0.26	-0.26	$\frac{V_L}{V_{RS}} = \frac{0.078}{0.230}$
Discomfort score	8.4	7.7	8.2	$\frac{V_L}{V_{LS}} = \frac{5.0}{17.9}$

* Significant at the five-percent level.

† Significant at the one-percent level.

fusion frequency and in the recognition time, and the discomfort score were statistically significant at the one- and five-percent levels, respectively. The importance to be attached to these differences will become clearer after we have considered the differences between the three levels of illumination, L_1 , L_2 , and L_3 , representing 5, 100, and 300 foot-candles, respectively.

Let us begin with the composition of the "between levels" variance, V_L (see tables 3 and 4). The term $\sigma^2_{L \times S}$ exists—that is, is significantly different from zero for average performance ($V_{L \times S}/V_{RS} = 259.6/23.9$), average blinking rate ($27.2/4.9$), and the discomfort score ($17.9/7.7$). In the latter two functions, $\sigma^2_{L \times I} = 0$ and $V_{L \times S}$ is the proper error term to be used in the F tests.

For performance decrement, flicker fusion frequency, recognition time, and rate of eye movements we may pool V_R , $V_{L \times I \times S}$, $V_{L \times S}$, and $V_{L \times I}$. In this way we obtain V_{RS} , with 88 degrees of freedom.

There is no simple legitimate error term for V_L in the case of the average performance, in which both $\sigma^2_{L \times I}$ and $\sigma^2_{L \times S}$ are present in amounts significantly different from zero. However, we have seen that $V_{L \times I}$ just barely reached the five-percent level of significance. Consequently, we may use the ratio of $V_L/V_{L \times S}$ as the first approximation (see table 7).

The F ratios turn out to be highly significant. From the estimation equations for $V_{L \times I}$ and $V_{L \times I \times S}$ we arrive at $\sigma^2_{L \times I} = 2.6$. Similarly, $RSI\sigma^2_L = V_L - V_{L \times I} - V_{L \times S} + V_{L \times I \times S} = 5,136.10$; $\sigma^2_L = 5,136.10/36 = 142.7$. This is a much larger value than that for $\sigma^2_{L \times I}$ and we may rest satisfied that the F-test $V_L/V_{L \times S}$ was a satisfactory approximation to a test for the significance of the differences between the average performance at the three levels of illumination.

Another approach would be to obtain an "error" term which would include all components except σ^2_L , in the form $V_{L \times I} +$

$V_{L \times S} - V_{L \times I \times S} = 290.90$, a value which is only slightly higher than the term $V_{L \times S}$, used above in testing the F-test of significance.

In addition to the average performance, the performance decrement, the average blinking rate, and the change in the recognition time differ significantly at the three levels of illumination. The fact that the marked differences in illumination (5, 100, and 300 foot-candles) were not paralleled by a significant difference in the change of flicker fusion frequency, the change in rate of eye movements, and in the discomfort score should be noted. Strangely enough two of these functions, the first and the last, differentiated between the three illuminants.

The fact that the "order of excellence" differs, with least change in flicker fusion frequency in illuminant I_1 and least discomfort score at illuminant I_3 , plus the fact that very marked differences in the illuminating environment—represented by the three levels of illumination—failed to be reflected in the means for these variables, makes the true significance of the observed differences between illuminants anything but a straightforward matter. Undoubtedly there will be some who will be tempted to minimize their importance. But it may be pointed out that, statistically, the validity of the differences between illuminants is the same as the validity of the differences between the levels of illumination.

BIOLOGIC SIGNIFICANCE OF THE DIFFERENCES

METHOD

Statistical significance of a difference is certainly the experimenter's first concern. Where the results lack statistical significance—that is, where the differences between the means could just as likely result from the effects of chance factors—there is little point in pursuing the analysis further. However, "statistical significance" of a difference between two or more conditions is by no means the whole story. Actually, it is only the beginning of the story.

"Statistical significance" says nothing about the biologic (or practical) importance of the differences. The relative level of performance or the degree of deterioration in visual functions (fatigue), observed under a given set of conditions, can be defined satisfactorily when we know the scores obtained under the most strenuous work conditions and scores obtained under the optimal work conditions. This difference gives us a range within which the experimental factors can operate.

The lower limits for our type of strenuous visual work were established principally under the extremely unfavorable conditions of two hours work at two foot-candles and four hours work at five foot-candles.⁹ The subjective fatigue produced by these procedures approached the limit of tolerance for

TABLE 8
RANGE BETWEEN THE "BEST" AND "WORST" SCORES OBTAINED UNDER SPECIFIED WORK CONDITIONS
The work period was two hours, except for a few values referring to a four-hour work period

	Best Score	Worst Score	Range
BEFORE WORK-AFTER WORK CHANGES			
Flicker fusion frequency	0.7 (50 ft.-c.)	3.1 (5 ft.-c. 4 hrs.)	2.4
Recognition time	0.1 (300 ft.-c.)	3.7 (5 ft.-c.)	3.6
Discomfort score	7.7 (100 ft.-c.)	12.2 (5 ft.-c. 4 hrs.)	4.5
BEGINNING-TO-END CHANGES			
Performance decrement	6.8 (100 ft.-c.)	26.0 (2 ft.-c.)	19.2
DETERMINATIONS MADE DURING THE WORK PERIOD			
Average performance	189.3 (100 ft.-c.)	145.3 (2 ft.-c.)	44.0
Average blinking rate	5.8 (100 ft.-c.)	9.8 (5 ft.-c.)	4.0

TABLE 9

RELATIVE DETERIORATION OF PERFORMANCE AND OF VISUAL FUNCTIONS AT DIFFERENT LEVELS OF ILLUMINATION

The values are differences between the mean score obtained under a given level of illumination and the best score, expressed as percentage of the difference between the worst and the best score, indicated in Table 8

Function	Level of Illumination (in foot-candles)					
	(2)	5	15	50	100	300
Average performance	(100.0)	49.8	18.4	2.3	0.0	3.0
Performance decrement	(100.0)	38.0	15.6	16.1	0.0	21.4
Average blinking rate	(62.5)	100.0	35.0	22.5	0.0	62.5
Change in recognition time	(77.8)	100.0	80.6	69.4	27.8	0.0

The values at two foot-candles are based on six, those at higher foot-candle levels on 36 determinations.

normal young men tested under experimental conditions.

Such stress would be present in actual working conditions only in case of an emergency. Nevertheless, the obtained range does not represent the absolute physiologic range of possible differences. Furthermore, the sensitivity of the various visual functions to the imposed visual stress will certainly differ. The use of percentages covers up this fact. Small absolute differences may be "blown-up" out of all proportion to their true biologic importance.

These limitations are inescapable in the present state of our knowledge but they should be kept in mind in interpreting the findings. The ranges between the "best" and "worst" scores and the conditions under which these scores were obtained are indicated in Table 8.

The relative amount of deterioration can be then expressed as

$$100 \times \frac{(\text{Given Score} - \text{Best Score})}{(\text{Worst Score} - \text{Best Score})}$$

In the case of average performance, where higher values represent more "desirable" scores, the values are obtained as

$$100 \times \frac{(\text{Best Score} - \text{Given Score})}{(\text{Best Score} - \text{Worst Score})}$$

LEVEL OF ILLUMINATION

Table 9 shows the relative amount of deterioration in those functions which exhibited

statistically significant differences between the three levels of illumination (5, 100, and 300 foot-candles). For reasons of completeness the values for two foot-candles and the intermediary levels of 15 and 50 foot-candles were also included.

In the average performance score there was a striking improvement when the illumination level was raised from two to five foot-candles, the improvement representing one half of the total range between the best and worst score. There was a further marked improvement at 15 and 50 foot-candles. The optimum was reached at 100 foot-candles but the differences between the scores at 100 foot-candles and either 50 or 300 foot-candles were small.

The values for the performance decrement at the six levels of illumination paralleled, in the gross outline, the pattern of the average performance. It showed a more marked optimum at 100 foot-candles. The average blinking rate showed also an optimum at 100 foot-candles. The pessimum for this function was obtained at five foot-candles.

The lack of further deterioration under the added stress of either more prolonged work or the illumination level decreased to two foot-candles complicates the interpretation of the average blinking scores as an index of visual strain.

Like the recognition time for threshold-size details, it is a rather variable function and the results might have been internally

more consistent had the means been based on a larger number of determinations. The mean value at two foot-candles was based on only six determinations (one testing of the group of six subjects). The recognition time showed also a pessimum at five, not at two foot-candles. The change in recognition time was the only fatigue index which showed improvement continuing beyond the level of 100 foot-candles.

Considering the total picture, the performance—both as the average level of two-hour performance and as decrement from the beginning to the end of two hours of work—yielded the most sensitive and sensible index of adequacy of the level of illumination.

ILLUMINANTS

The mean scores for the three illuminants (I_1 = verd-a-ray, I_2 = ordinary inside frosted lamps, I_3 = natural white) were given in table 6. Only the change in the fusion frequency of flicker and the change in recognition time after two hours of visual work showed a highly significant differentiation between the illuminants.

Differences in the mean discomfort scores were significant at the five-percent level of significance. It may be noted that, out of the three functions just cited, only the recognition time differentiated also among the levels of illumination and even there the behavior of the scores was somewhat erratic (see table 9).

The relative differences between illuminants are given in Table 10. The sign of the differences indicates the relative superiority (+) or inferiority (−) of the first illuminant as compared with the second illuminant. The direction as indicated by "+" or "−" does not necessarily coincide with an increase or decrease of the actual score. If the first of the two compared illuminants showed a lesser deterioration than the second illuminant, the sign of the difference would be "+," though the actual score changes in the direction of deterioration for both illuminants.

The first striking impression imparted by

TABLE 10

EFFECT OF SPECTRAL QUALITY OF LIGHT ON VISUAL FATIGUE

The differences between the three illuminants were expressed as percentages of the total range of differences indicated in Table 8

Function	I_1 vs. I_2	I_1 vs. I_3	I_2 vs. I_3
Change in flicker fusion frequency	+48.3	+63.3	+15.0
Change in recognition time	+81.1	(+112.2)	+31.1
Discomfort score	+33.3	−8.9	−42.2

+ = relative superiority; − = relative inferiority of the first of the two illuminants compared.

data in Table 10 is that the differentiation of illuminants in regard to the fusion frequency of flicker as well as the recognition time is unexpectedly large in respect to the maximum biologic range.

The fact that the differences in the recognition time exceed the maximum deterioration range is explained by the different direction of changes with different illuminants (slight improvement in I_1 , deterioration in I_3).

The differences in the discomfort score have also sizeable magnitude in respect to the changes produced by maximum stress. The data appear to support the view that slight color differences may be of consequence for minimizing the visual fatigue.

Is this a valid inference? The basic data were obtained under rigorously controlled conditions, over a period of weeks, with the illuminants varied in such a way as to avoid any bias. We believe that our procedure of the evaluation of the relative magnitude of the differences between experimental conditions is basically sound.

It might, of course, be argued that even the most strenuous work conditions used in the present series did not establish the biologic "zero" with reference to which the relative amount of deterioration should be expressed. We agree that, under work conditions used in this series, we have not reached the limits of possible deterioration—for example, the changes in flicker fusion

frequency, resulting from inhaling air mixtures low in oxygen, result in much more profound depression of the scores than we have observed even under the most strenuous visual conditions. This would apply to other functions as well. Yet we wished to remain within a range of the visual stresses which has practical applicability.

We are well aware of the complexity of research on man. The process of making general inferences from the available experimental data must be cautious. The variability of the responses of human organisms to a given stress and the possibility of chance variations affecting the results cannot be

neglected. Certainly the absence of significant over-all differences in the performance criteria should temper any undue enthusiasm about the importance of differences in the spectral quality of mixed white light.

The existing literature on the effects of spectral quality of the light presents by no means a consistent picture. Data strictly comparable to those obtained in the experiments reported here are absent. Only further research can clarify the results obtained in this study as far as the importance of the spectral quality of light is concerned.

Stadium Gate 27 (14).

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OPHTHALMIC MINIATURE

The reaction of the pupil to light is almost as accurate an indicator of the visual acuteness of the retina as the galvanometer is of an electric current.

Lieut. Col. Henry Jullunder Smith,
Brit. M. J., 1903 (Sept.) p. 720.

MALINGERING IN RELATION TO VISUAL ACUITY*

A REVIEW

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Tardieu once remarked that malingering is as old as lying, and that among its votaries have figured not only the poor and lowly but even the most exalted personages. There is no necessity for emphasizing the importance of this subject to the practicing ophthalmologist, who, willingly or unwillingly, often finds himself involved in legal proceedings—often to his great discomfort. He is constantly reminded of the fact that he is not treating a disease, but a patient—and that patient exhibits all the strengths and frailties of mankind.

The problem of detecting and exposing malingerers is assuming ascending importance in this age of rapid socialization—of care from "cradle to grave."

The shirking of personal responsibility has led to an increased centralization of governing agencies in all phases of American life. With increasing benefits to the unemployed, to the sick, to the disabled, to the indigent, and to the aged, it has become more profitable not to work than ever before.

A decreasing number of workers are supporting not only an increasing number of indigents, but also an increasing number of malingerers who find more profit in feigned disability than in providing for themselves. Thus the problem of malingering has far-reaching social and economic implications.

The problem, as it often presents itself to the oculist, is as difficult as it is distasteful. If he attempts to prove feigned disease he must be familiar not only with all the normal manifestations of disease, but also with the aberrant forms.

As Beaumont has said: "Even if the story we are told is a tangle of impossibility,

copied from the repertoire of the father of lies, and worthy of the mother of invention, it may have a genuine pathologic basis."

The price to be paid for error in diagnosis is indeed high—the righteous indignation of a man whose character has been unjustly maligned brings not only double injury to the patient, but also discredit to the physician who incorrectly accuses the patient of willful deceit. And if it is difficult to establish a diagnosis, how infinitely more difficult is it to prove that the patient is not only not ill, but malingering!

The problem, however, is even more complex. For medicine is neither static nor exact. What physicians today call a neurosis may tomorrow be a new syndrome or a new disease, recognized and labelled for the first time. So the problem is not to be entered into lightly or inadvisedly.

The diagnosis of malingering is a special problem utilizing methods not usually included in the examination of a patient whose subjective responses are assumed to be truthful. It is a diagnosis built on positive evidence rather than a diagnosis of exclusion. As soon as it is first suspected, factual evidence must be accumulated to substantiate the diagnosis.

Care must be exercised to distinguish between the patient who, clumsily or artfully, tries to deceive the examiner and the hysterical patient who deceives himself.

Since the field of malingering is as large as the imagination of the deceiver, the present discussion must necessarily be limited in scope. I shall deal primarily with complaints of defective vision, which frequently may be subjected to a careful analytic differentiation, which, of necessity, depend upon a knowledge of physiologic optics.

A brief resume of the psychodynamics of hysteria will conclude the paper in order that

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the problem, as presented to the physician, may be reviewed in full.

AMAUROSIS

The simulation of bilateral blindness is an unusual occurrence because of the difficulty in assuming and maintaining the pose. The malingerer may succeed in his deception and receive material reward for his "handicap" but the inconvenience of assuming the role of complete blindness makes such simulation arduous and unpleasant. Fortunately, the detection and exposure of such cases is, as a rule, easy.

With few exceptions, organic amaurosis is accompanied by other physical signs of dysfunction, foremost among which are aberrant pupillary reactions. A searching inquiry into the details of any injury or onset and an exact understanding of the amount of residual vision claimed by the patient are essential.

PUPILLARY RESPONSES

If the claimant states definitely that he has no light perception, the examiner may logically expect the pupils to be dilated and fixed to light. In this regard, however, certain pitfalls must be scrupulously avoided.

The physician must be satisfied that the anomaly is not congenital, that it is not caused by posterior synechias or other disease of long standing, by anisometropia, by the legitimate use of mydriatics or miotics, or by central nervous-system disease.

A pupil which does not react to direct light should immediately be tested for its consensual reflex by shining a bright light into the opposite eye. If mydriatics have been used, the pupil will not react.

It is likewise a general rule that a blind eye will give neither a direct response nor a consensual reflex in the contralateral eye, although cases have been reported in which pupillary responses have been retained in the presence of optic atrophy (Rothmann, 1894; Henschen, 1894; Schirmer, 1902; Librecht, 1907; Mandelstamm, 1908; Behr,

1909; Goldflam, 1912; Alexander, 1924; Wirth, 1924; Magnus, 1928; and Gifford and Mayer, 1931).

Abelsdorff (1919) reported the opposite condition, and Lacquer (1908) reported a case of amaurosis and pupillary paresis in which the pupillary function returned before the visual.

Since the patient claims blindness, tests for accommodation usually cannot be expected to be of value, but testing for the lid reflex, the oculosensory reflex, and the psychosensory reflex (all of which are independent of vision) may assist in differentiating lesions of the afferent and efferent pupillary pathways.

Even without resorting to the use of mydriatics, the malingerer may find apparent corroboration for his claim of blindness if an internal ophthalmoplegia has been previously called to his attention. In this connection it is important to recall that very rarely this paralysis may be a congenital anomaly.

Other causes for pupillary dysfunction are various and include syphilis, polioencephalitis, cerebral neoplasms, glaucoma, senile dementia, migraine, diphtheria, and severe poisoning such as botulism.

There is another notable exception to the rule that pupillary reactions are absent in cases wherein light perception is absent. This occurs in lesions situated in the optic pathway above the point at which the pupillary fibers leave the optic tract, in which case, of course, the lesion would be bilateral, or hemianopia rather than blindness would result. It may also occur when the entire cortex is unresponsive, as in uremic amaurosis.

It is likewise of interest to note that the psychosensory reflex is absent in patients with an Argyll-Robertson pupil. On the other hand, as a rule, there is miosis with this condition and, if blindness is claimed, suspicion should be excited.

In any case in which there is an irregularity of the pupil and one doubts that it is

really due to trauma, serologic tests for syphilis should be made. If, subsequently, optic atrophy supervenes, a luetic or traumatic etiology cannot always be differentiated.

A point which may be of importance in differentiating retrobulbar neuritis was described by Marcus Gunn in 1904. In unilateral disease of the retina or optic nerve, the pupil on the affected side will respond minimally to light stimulation; however, a striking dilatation of the pupil follows covering of the unaffected eye.

Since the dilatation does not occur if the good eye is not covered (merely protected from the light directed at the affected eye), the reflex appears to be due to the normal consensual reflex dilatation masking the impaired direct reflex in the affected eye.

This pseudo-anisocoric sign of Kestenbaum is of greatest value in differentiating between organic and functional conditions when the fundus is normal.

The other major lesions which must be considered are those affecting the autonomic nervous system. A spastic mydriasis occurs as a result of sympathetic irritation. It is often accompanied by widening of the palpebral fissure and exophthalmos and may be distinguished from paralytic parasympathetic mydriasis by the retention (although markedly diminished) of the light and near reflexes.

The reverse of such a situation is a paralytic miosis which causes the classical syndrome of Horner and which may be differentiated on the basis of lack of pupillary dilatation after the use of cocaine.

In some cases of trauma to the cervical spine, the miosis is so slight as to escape notice unless the patient is examined after being placed in the dark, when it will be noted that one or both pupils do not dilate.

In anisocoria, when the abnormal pupil is the smaller, the use of miotic drugs should be suspected if there is no sympathetic paralysis and no question of iritis. Further, it must be recalled that miosis may be a con-

genital anomaly and occasionally heralds the onset of irritative nervous disorders affecting the parasympathetic fibers.

These varied organic dysfunctions, as well as their unusual manifestations, must be considered before the examiner can understand the organic or functional components in any individual case. Just as it is possible to have organic disease without confirmatory organic clues, it is likewise possible to have functional disorder with suggestive organic signs.

TESTS FOR AMAUROSIS

Insofar as the detection of simulated bilateral amaurosis is concerned, the majority of the tests are, of necessity, objective in nature. Careful observation of the subject sometimes reveals clues which excite suspicion.

While a blind man moves cautiously and bumps into things naturally and the hysterical patient often avoids obstacles with apparent intent, the malingerer, in his anxiety to prove his disability, often over-plays his part and goes out of his way to create collisions.

Arlt early pointed out the importance of illuminating the macular area with an intense light; in a light-sensitive retina, this will cause lacrimation and blinking.

1. *The menace reflex.* A sudden, surprise movement toward the face often causes the subject to blink even though he knows that no contact will be made. The practiced malingerer may suppress this reflex, but Fallot (1836) observed that a seeing man is unable to prevent increased heart rate. Baudry suggested protecting the patient's eyes with plain transparent glass and blowing dust toward the face, noting whether the eyes close.

2. *Head rotation test.* If the examiner rotates the subject's head through an arc of 30 degrees alternately to the right and left, the presence of nystagmus suggests extremely poor vision or blindness. If the eyes remain in their original position despite head motion, a fixation reflex is inferred.

3. *Schmidt-Rimpler test (1871-76)*. The patient's hand is placed in some position in front of him and he is asked to look at it. The malingerer, believing position sense to be a function of vision, usually looks in another direction. It has been repeatedly observed, however, that a blind person, fearing that his blindness may be discredited by his performance of this test, may mangle and confuse the interpretation of the results.

Position sense is a function of the posterior-column system and will be affected by a lesion in any portion of the system, whether it be cervical or lumbar cord, mesial fillet in the brain stem, or the thalamus.

Posterior-column ataxia does not occur without sensory defects (vibration and light touch), and other signs of ataxia can be elicited such as a positive Romberg sign, dysmetria, and flapping gait. The cerebellum is not concerned with sensation, and even in severe cerebellar disease there is no impairment of sense of position and movement.

4. *Prism test of von Welz*. A small light is placed in the direction to which the gaze is apparently directed and a 10-diopter prism base-out is suddenly placed before the "blind eye." If there is a compensatory fusion mechanism, the eye will be observed to turn in for at least a moment.

A practiced malingerer may be able to overcome prismatic effect but, if the prism is placed in a frame and he is permitted to wear it for a while, it is extremely difficult not to fuse. Even if one eye is really blind, the seeing eye may move behind the prism in a fixation reflex but, according to Jackson, the blind eye will move in the same direction to the same extent. Both eyes should be tested in this way in binocular amaurosis. The test, of course, depends on binocular fusional vision.

5. *Optokinetic nystagmus test*. Optokinetic nystagmus, first described by Purkinje in 1825, occurs when successive moving objects excite attention as they cross the visual field. Clinically, it is most easily obtained by having the subject observe a rotat-

ing vertical drum marked with vertical stripes.

It is especially useful in differentiating functional and organic complaints, since a response is obtained so long as a person has enough vision to see the drum and enough intelligence to appreciate it—neither central nor peripheral vision is alone essential.

Ohm (1922) pointed out the cerebral origin by demonstrating nystagmus in the covered normal eye when the other eye with total ophthalmoplegia was stimulated. The optimum response of about 75 nystagmic movements per minute is obtained when the rate of the succession of objects is between three and 12 per second.

Although vestibular nystagmus is primarily subcortical, optokinetic nystagmus depends more upon fixation and refixation reflexes which are mediated by cortical centers independent of the subcortical mechanism.

Hence, lesions involving the higher visual cortex and their associational tracts or the motor tract to the oculomotor muscles cause ablation of the response in the affected visual field (referring to the direction of rapid phase). If the drum rotates before a malingerer and one eye is examined ophthalmoscopically, a slight nystagmus will be noted.

6. *Electro-encephalography*. In 1942, Lemerre suggested the use of this procedure for detection of malingerers on the basis of the observation that the normal Berger rhythm is damped or stopped when light or an object is seen. However, Callahan and Redlich (1946) observed 100 cases of varying types and found that, while this reaction was generally true in the normal individuals studied, there are exceptions, particularly in those with fast rhythms.

Duke-Elder (1949) is in agreement that the method may have some merit but that certain differentiation of true and false blindness is not possible and the results have no medico-legal value.

Further studies by Redlich, utilizing the galvanic skin response, have been shown

to be of definite value. This skin response is the bio-electric current accompanying sweat-gland and vasomotor activity induced by sensory stimuli, attention, and various psychologic situations (Landis, 1932, has reviewed the various methods used).

Redlich stimulated the eye with a powerful light (3,000 foot-candles at three feet) and recorded the galvanic skin response with a Gass electro-encephalograph. A deflection was noted when visual perception was present; the same stimulation of the totally blind eye induced no response.

7. *Anesthesia.* Hutchinson suggested that, as a last resort, the subject be anesthetized with ether, in the hope that, if blindness was being simulated, the simulator might reveal his ability to see before his consciousness returned sufficiently to permit him to resume his deception.

Along this same line, the use of more modern anesthetics, such as intravenous pentothal sodium or sodium amytal, might be considered if the simpler methods fail.

MONOCULAR AMAUROSIS

A large number of valuable tests are available for detecting simulated monocular amaurosis. It will, however, become immediately apparent that the physician faces two major problems: (1) To prove that some vision actually exists and (2) to establish as accurately as possible the amount of vision which is present.

Although the overlap in these problems is marked (especially since a subject simulating amaurosis will change his claim to amblyopia if he is detected), an effort will be made to divide the problem arbitrarily in this fashion.

TESTS

If the subject claims good vision in one eye and complete blindness in the other, the good eye may be covered and the person should become, in effect, totally blind. If this is done, the tests for binocular amaurosis may be applied with facility.

There are, in addition, more elaborate techniques, usually tricks to combat trickery, to make the malingerer admit vision in his "bad" eye when he believes he is seeing with the eye he admits is good. It must be emphasized, however, that the examiner must concentrate on the subject to make certain that he does not close one eye and thereby defeat the purpose.

The patient's required correction, determined by retinoscopy, should be used throughout the examinations whenever feasible to eliminate any clues which might assist the patient in identifying a blurred image with one eye. If there is reasonable doubt that he may still gain such information, it may be helpful to smear a very thin layer of vaseline over the lens covering the better eye.

One of the simplest of the older techniques is to place a prism base-up before the allegedly blind eye and have the patient ascend and descend unfamiliar stairs rapidly. If the eye is really blind he should experience no difficulty, but if he has two seeing eyes, the resulting diplopia makes the performance anything but easy.

Baumont cites a test used by Wick of Berlin wherein the patient is shown two candles at 20 feet with a plane glass before the "bad" eye, after which the examiner stands in front of the patient to change the glass to a prism placed horizontally while an assistant removes one candle. The patient is then asked to describe the relative position of the two lights and if he admits seeing two, it is obvious that he has vision in both eyes.

Several simple tests of fixation are helpful if the patient has binocular single vision.

In von Welz's original test (1867), a 10- to 20-degree prism base-out is placed before the allegedly blind or amblyopic eye while the patient is reading rapidly. If the suspected eye has appreciable vision, it will deviate inward and, on removal of the prism, deviate outward.

Duane (1924) suggested a similar test

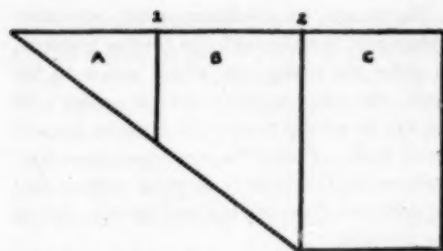


Fig. 1 (Kleckner). The prism is placed in a circular brass container with perforations at points 1 and 2.

using a four-degree prism base-down to create a confusing vertical diplopia of small amount. Smith and Jackson employed a point source of light at six meters in performing the prism test. Berthold rotated a 20-degree prism before the suspected eye and asked the patient to read small print rapidly (the reading is very difficult if the vision is good in both eyes).

Falta (1915) used a simple test for fixation in which the near point of convergence is tested—the eye that turns out should be the suspected eye and, if it resumes fixation when the opposite eye is occluded, the fixation impulse indicates that vision is present.

Other tests for binocular vision utilizing the principle of diplopia have been of particular value. One of the oldest was suggested by von Graefe in 1867. He recommended covering the suspected eye and producing monocular diplopia in the other eye by bisecting the pupil with the sharp edge of a 10-degree prism.

When the subject has been shown that monocular diplopia is possible, the cover is removed from the suspected eye and at the same time the prism is moved to cover the whole pupil. He is then asked to describe the relative position of the lights. Since monocular diplopia has been supplanted by binocular diplopia, his admission that he sees two lights demonstrates vision in both eyes.

Although the test is excellent from a theoretical point of view, it has certain serious defects which render it almost useless in the

case of the stupid malingerer, and uncertain with the clever one. The main difficulty is to set the prism at precisely the right point and prevent motion of head, eyes, or prism.

As Baudry pointed out in 1881: "The subject must be intelligent, the edge of the prism must be very sharp, and the eye itself must remain motionless. If any of these conditions fail to be present, or even if the pupil contracts but slightly, the double image will immediately disappear."

Baudry surmounted these objections by using a dark-red light at two to three meters for fixation (in order to make the real and false images indistinguishable) and then placing a special prism before the admittedly good eye.

He placed the prism in a circular brass container (fig. 1) with perforations on either side at points 1 and 2. The subject, viewing the fixation light through the perforations, is then unable to ascertain whether he is seeing through the base only or the whole prism, even if he happens to be acquainted with the apparatus. Monocular and binocular diplopia are more quickly and easily reversed by this technique.

Baumont has suggested a more simple technique to obviate the uncertainty of von Graefe's test. A pair of binoculars are placed before the patient's eyes, forming, in effect, a conical extension with an enlarged pupil. The exact amount of prism covering the objective lens of the binocular is of no consequence—the patient experiences immediate diplopia with that eye.

A procedure similar to von Graefe's is then used, the speed of transition from monocular to binocular diplopia being unimportant since it is not detected by a binocular patient. Also, by substituting Snellen charts and having the subject read both images, the vision can be approximated if the magnification factor of the binocular is considered.

Todd (1912) suggested the use of a double prism which is presently used for testing cyclophoria and is, therefore, easily accessi-

ble. It is a useful preliminary test for the more naïve malingerer. The good eye is covered by the prism and the subject is asked to describe the location of the images. If he sees three lights, he is seeing with both eyes and, if he denies the existence of two, he is obviously dishonest.

Some of the most practical tests make use of visual-field determinations. In von Szily's test the field is plotted at two meters' distance with both eyes open. If the subject has two seeing eyes, the target will be seen on the blindspot of the admittedly good eye.

Further, the presence of unilateral blindness leads to ipsilateral loss of only a temporal crescent if the visual fields are taken with both eyes open. The malingerer will often claim that he cannot see the target after it passes the midline into the field of the alleged blind eye—rarely will he admit the loss of only a temporal crescent (Cuignet, 1870).

The bar test of Javal (1867) and Cuignet (1870) and the numerous modifications which have been devised often aid in detecting simulation, and certain of the modifications purport to measure visual acuity.

The original test called for the interposition of a pencil or finger midway between the eyes of the subject and print held about 35 centimeters from the subject. A patient with monocular vision will be unable to read the entire line if his head remains in a fixed position because of the obstruction offered by the pencil, but a person with binocular vision reads without hesitation because of the overlap of the visual fields.

Martin (1878) constructed an apparatus using the Javal method and standardizing the procedure somewhat. It consists of a box (such as a shoe box) 35-cm. long and 20-cm. wide, one end of which has two holes to serve as eyepieces and the other end of which holds test letters. Fifteen cm. in front of the letters is placed a rod one centimeter in diameter which can be raised or lowered at will.

Barthelemy (1872) devised an apparatus which can be used as a stereoscope or a pseudoscope. It consists of a large square ruler, measuring 50 cm. and graduated in centimeters, over which two travellers can be moved. One of the frames serves as a screen and the other holds a test card. The eyepiece can be fitted with prisms or correcting lenses, and mirrors can be attached to one of the travellers in such a way as to reproduce the stereoscopic tests with the former or the Fles box with the latter.

A further modification was suggested by Driver (1872), who recommended interposing a ruler, four-cm. wide, at a definite distance between the eye of the patient and two of Snellen's test types in such a way that the ruler would screen the right test-type from the left eye and the left test-type from the right eye. If the patient is then able to read both cards, his simulation is proved and, at the same time, his visual acuity in the supposedly poor eye can be measured.

Another large group of tests utilizes colors and works on the principle that similarly colored rays may pass through a colored glass while complementary colors are stopped.

One of the oldest and best of these color tests is that of Snellen (1877), still used today. If Snellen charts, with alternate red and green letters, are viewed through glasses holding red glass for one eye and green for the other, the examiner can identify the eye being used to read the chart, as well as approximate the visual acuity.

Snellen originally used a wooden frame, 60-cm. long and 15-cm. wide, enclosing alternate letters of red and green transparent glass. By sliding a shutter, the examiner could change the red letters to green and vice versa.

Pearson introduced a modification, using prisms to transpose the letters and add confusion. Todd suggested printing on white paper alternate words in red and black, then

placing a red glass over the seeing eye, if the other eye was really blind, the patient should read only the black words. Beaumont suggested a similar test, using the patient's name (surname black and Christian name red) and purposely misspelling each name.

Worth used the Snellen principle in his "four dot test" in which colored dots, one red, two green, and one white, were shown to the subject while the eyes were covered with red and green glasses. Other methods of utilizing the principle have been proposed by Bravais, Dujardin, Minor, Fontorbe, Stoeber, Michaud, Symens, and many others.

Wolfberg's color test is useful for testing distance vision. It depends upon the well-known fact that a small red disc, two mm. in diameter, can be seen by a normal individual at five meters; whereas, a blue disc, to be seen at the same distance, must be seven mm. in diameter. Red and blue discs of varying size are then used for testing and the agreement with these known principles is checked.

The presence of physiologic diplopia was used by Wessely (1908) who recommended having the patient fix on a distant object through two short, slightly converged tubes held close to the eyes. While distance fixation is thus being maintained by the subject, the examiner holds a finger briefly before the tubes and asks how many fingers were noticed. The presence of the tubes makes physiologic diplopia irresistible if binocular vision is present.

The principle of intersecting the lines of sight of the two eyes has been the basis of a large number of tests which use instruments called pseudoscopes. In the earliest of these methods, Prato's tubes were used. There is one tube for each eye, and these cross each other at the midpoint of their length, thereby giving an apparent transposition of images. The tubes are enclosed within a box so that the intersection of the tubes is not obvious.

Gratema used similar tubes which permitted intersecting the lines of sight by look-

ing through small slits in the objectives displaced toward the nasal side. Modifications of Gratema's method were employed by Koster (1906) and Thies (1930).

The first of the mirror pseudoscopes was that of Fles (1860). It consists of a box with two mirrors at an inclination of 120 degrees, so arranged that the examinee is uncertain with which eye the image is perceived, since the images are crossed. At the front of the box are two holes through which the mirror images are observed and two additional apertures, fitted with ground glass, which the examiner can cover with his finger without the knowledge of the patient.

By looking through the sight holes, a circular reflection of the apertures is seen and it is impossible to say whether one or two eyes are being used except by a slight difference in intensity. To a binocular subject, blocking either aperture will not affect the image but a monocular subject will not see the circle of light if the aperture before the seeing eye is blocked.

Fles's box is simple but the small size of the apparatus requires the exercise of considerable accommodation. In addition, the fact that the images are very close to each other makes even an honest person's answers uncertain so that numerous modifications of this technique have been developed.

Baroffio, to remedy objections, altered the inclination to 125 degrees, and Binnendijk and Armaignac (1878) placed the mirrors on hinges. Mareschal (1879) used a box large enough to decrease accommodation and convergence and a single mirror with which the patient could not see his own eye. Marini (1889) adapted prisms to the eyepieces in such a way as to perform the test of von Graefe and to convert the pseudoscope into a stereoscope.

In Monoyer's double apparatus (1884), the patient sees the reflection of his own eyes as well as the images of objects or test drawings in two well-placed mirrors at the rear of a rectangular box. Also, screens in the floor of the Monoyer box allow the mir-

rors to be hidden and inclined as in the Fles box.

Astegiano (1889) attempted to improve the Fles box by substituting a graduated scale of reversed letters or symbols for the test cards in an effort to obtain an estimate of visual acuity but, according to Todd, the method is relatively inefficient.

The optoscope of Bertin-Sans (1885) is a box, 16-cm. long, 18-cm. wide, and four-cm. deep, with opaque walls except for two small openings on the front wall fitted with clear glass for eyepieces, at the side of which are two other round openings furnished with ground glass. On the opposite posterior wall, two plane mirrors, placed at a projecting angle so that the vertical planes cut at a right angle through its middle, make a horizontal line drawn from the center of the ground glasses to an imaginary point 25 cm. from the eyepieces (that is, at the distance of distinct vision).

As a result of this arrangement, the images of the ground and transparent glasses are seen by each of the eyes as a small luminous circle which superimposes with binocular vision and merely becomes less brilliant if one of the ground glass openings is occluded, making it impossible to tell whether the image of the right or the left aperture has disappeared.

Despite the numerous and diverse modifications of the Fles box, none of the tests permit the examining physician, even if the experiments prove successful, to assert more than the fact that the person is not blind in one eye.

Measurements of visual acuity are unreliable because the patient can usually compare the two halves of the scales shown him, take note of the letters seen by an amblyopic eye, and read accordingly. In addition, the weakening of light intensity by mirror reflection and by dispersion at the point of incident is a variable difficult to estimate. Hence, the pseudoscopic tests have a limited field of usefulness and the remark of Beaumont appears appropriate: "From parturient

mountains we are not satisfied with insignificant mice."

The Bishop Harman apparatus (1910) has the distinct advantage of providing a pseudoscopic test not utilizing mirrors. It is a modification of the small diploscope of Remy and can be constructed simply and cheaply. It consists of a flat piece of wood 8.5 inches long and 1.5 inches wide. At the distal end is a rack to hold test cards, and 4.5 inches proximal to the rack is a screen, 3.25 inches wide and 2.75 inches high, which is perforated by a window five-eighths inch square.

The apparatus is supported by a handle and the subject, sighting from the end of the instrument, looks with both eyes at the card through the opening in the screen.

The middle part of the picture is seen by both eyes, the right side by the left eye, and the left by the right eye. If the card was a series of numbers—1, 2, 3, 4, 5, 6, 7, 8, 9—the 5 would be the only number seen by both eyes, and a person blind in the left eye should read only 1, 2, 3, 4, 5.

Remy's original diploscope (1901) is similar in principle but requires convergence, which makes the test less certain than many of the others that have been mentioned. Since other more simple and less fallible methods are available, the Remy instrument is usually not recommended.

The value of using major amblyoscopes for detection of simulated blindness will be immediately obvious. In addition the easy accessibility of such instruments, as well as their ease of demonstration to the laity, has proven to be of immense help to the ophthalmologist.

When the tubes of the Worth amblyoscope (1895) are approximated, the images are crossed and the malingerer will often find that he has "seen" the wrong side even though the tubes appear to be almost straight.

Also, by neutralizing or removing the lenses of the amblyoscope, placing test types in line with each tube and asking the subject to read the lines seen by the better eye, the

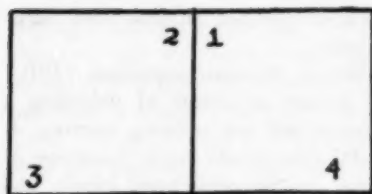
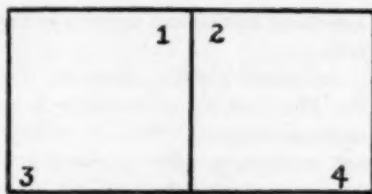
**CARD****IMAGES**

Fig. 2 (Kleckner). Two wafers, placed on a card, one red (1) on the right and the other black (2) on the left produce crossed images when observed through the stereoscope. To make the test more confusing, two additional wafers, one yellow (3) on the left and one blue (4) on the right, are used.

examiner may sometimes succeed in obtaining an estimate of visual acuity if the patient reads the chart on the same side as the better eye. Second-grade targets may also be placed at what should be the subjective angle, when it is not obvious that the eyes are seeing dissimilar images, and the malingerer is very likely to betray himself.

The first use of the stereoscope in detecting feigned monocular blindness has been credited to Lawrence by some authors and to Hogg by others. Regardless of the type of stereoscope used, the principle is the same in that two prisms are placed base-out before the eyes. The prismatic effect is used to produce superposition, fusion, displacement, or intercrossing of the images.

Although these instruments have proved to be satisfactory in numerous instances, they have certain inherent disadvantages which detract from their general applicability. The success of using stereoscopes depends upon binocular vision, and the presence of anisometropia or monocular amblyopia may confuse the results.

The malingerer may momentarily close

one eye (which, even if recognized, may be difficult to prevent) or may be able to recognize image positions by prismatic colorations or differences in clarity of the images. Hence, it has been found that utilizing methods involving displacement or intercrossing of the images has the best chance of success.

Vieusse (1875) used a simple arrangement (fig. 2) in which he placed two wafers, one red (1) on the right and the other black (2) on the left, one cm. apart on either side of the test card where the partition of the instrument occurs. These images will be crossed when observed through the stereoscope.

A better method is to use cards prepared as already described with two additional wafers five cm. apart (fig. 2), one yellow (3) on the left and one blue (4) on the right. As a result of this arrangement, the upper squares will be crossed and the lower ones approximated and the resulting confusion may provoke the malingerer to reveal himself.

Armaignac, in 1906, used a similar test with a different arrangement of black and white squares (fig. 3).

Monoyer recommended the use of slides with similar letters or a sentence on each side, a portion or a word of which is omitted from one or the other side. For the sentence to be complete both eyes must, therefore, be used.

Ten charts of increasing size are used to represent the 10 degrees of decimal typographic scale so that the acuity of vision can

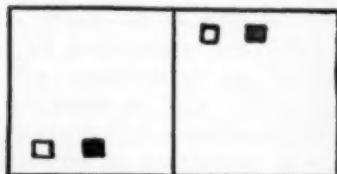


Fig. 3 (Kleckner). A test similar to that illustrated in Figure 2, using an arrangement of black and white squares.

be measured. The patient may first be tested with cards having identical sides to estimate how cooperative he will be, as well as to throw him off guard.

Again, the objection to this test is the fact that a subject with an amblyopic eye may recognize such images by the relative dullness or paleness. This difficulty was circumvented by Hoor who used colored discs of varying size, and of alternately lighter and darker shades on either side.

Other modifications by Rabl-Rückhardt (1873), Burchardt (1891), Schröder (1883), and Segal have helped to perfect the stereoscopic tests.

The American stereoscope, first applied to such testing by Rabl-Rückhardt in 1873, offers the examiner the opportunity of watching the patient's eyes constantly. At the slightest attempt to close the lids, the physician, by using the sliding chart of Burchardt or the sliding apparatus of Schröder, can quickly show a negative card or test-chart.

Segal introduced cards which are identical on the two sides but of complementary colors so that in the process of fusion the letters or objects become grayish-white.

Lastly, the stereo-optometer of A. Baldanza (1897) is a cleverly designed box provided with four 12-degree prisms placed before the eyepieces. The front prisms are stationary in base-out position, while the two rear prisms can be rotated to double or neutralize the power of the first ones.

The box is divided longitudinally by a screen so that the types on either side can be seen only by that eye. The arrangement of the prisms allows a series of combinations capable of baffling the most clever malingerer, even if he is familiar with the principle of the test.

AMBLYOPIA

The detection of simulated amblyopia often becomes a battle of wits and, as such, is one of the most interesting of the group of simulated diseases. In general there is a correlation of visual acuity with the amount

TABLE 1
UNCORRECTED HYPEROPIA WHICH CANNOT BE
OVERCOME BY ACCOMMODATION DECLINES

Diopters	Hypermetropia	Vision
0.5	Absolute	20/30
0.75	Absolute	20/43
1.0	Absolute	20/50
1.5	Absolute	20/100
2.0	Absolute	20/150
2.5	Absolute	20/200
3.5	Absolute	20/300
4.5	Absolute	20/400

of ametropia present. Thus Eggers (1945) found the uncorrected hyperopia which cannot be overcome by accommodation declines as shown in Table 1 (the proportion increasing, of course, with age).

The corrected visual acuity frequently falls into the class of amblyopia, so that Broekema (1909) found that normal acuity could be obtained in 82 percent of hyperopes with an error of 1.0D. to 2.0D.; in 63.5 percent of those with 3.0D. to 4.0D.; in 44 percent, from 5.0D. to 6.0D.; and in only 15 percent when the error was from 7.0D. to 10D.

As a consequence, uniocular amblyopia is a common condition and, according to Downing (1945) in a review of 60,000 United States military selectees, almost five percent of men from military age were found to have a uniocular amblyopia of 20/40 or more, the commonest etiologic factor being hypermetropia.

Although it is impossible to predict in any individual case what the uncorrected vision should be, statistics have shown a remarkable correlation in the cases of myopia. Hirsch (1945) found in a study of 64 eyes with myopia ranging from -0.5D. to -13.5D., that the plot of the logarithm of acuity on the logarithm of the degree of myopia gave a correlation of -0.95. Visual acuity, uncorrected, is reduced in about the same ratio as equivalent degrees of hypermetropia.

In general, the diminution of acuity is about equal for corresponding degrees of

simple hyperopic and myopic astigmatism, and both are considerably less than equal degrees of myopia or absolute hypermetropia. Again, Eggers' figures may be cited (table 2).

Also, as in cases of uncorrected myopia or hyperopia, perceptual amblyopia develops in many cases of higher degrees of astigmatism especially if optical correction is not given early in life.

From the above figures, two facts are immediately obvious: (1) That the ophthalmologist frequently sees bona-fide cases of unilateral amblyopia and (2) that false attribution is more likely to be the problem at hand rather than actual simulation.

Bilateral amblyopia, on the other hand, is much less frequent. Agatston (1944), in reviewing records of United States draftees, estimated ocular malingering to vary between 0.5 percent and 3.0 percent; that is, out of every one million men examined there were between 5,000 to 30,000 malingerers. Yet in a review of 20,000 cases he found only 11 cases of bona-fide binocular amblyopia, seven of which had congenital nystagmus with high myopia, high mixed astigmatism, or albinism.

Therefore, when the examiner is unable to correct an amblyopia optically and finds no assignable etiology, he should consider a few simple experiments to rule out simulation which will otherwise go unrecognized.

Since the visual angle required by an amblyopic patient remains unchanged, his reading ability should correspond with this visual angle at varied distances from the chart. Hence a person with 20/100 vision requires a visual angle of five minutes and, if he be placed 10 feet from the chart, he should be able to read the 20/50 line; that is, 20/100

vision should correspond with 10/50.

The variation may be made greater by checking vision at 10 feet, then having the subject turn around and read the chart through a mirror image at 20 feet; making reasonable allowance for difference in illumination and clarity of a mirror image, the distance is three times greater in the latter instance and, since the subject's visual angle requirements should remain unchanged, his reading ability should be limited to letters three times the size of the former. Hence, a person who can read the 20/200 line at 30 feet should read the 20/50 line at 10 feet or 20/100 at 20 feet.

The "E" chart is preferable, of course, because of reversal of the images. The subject's appreciation of distance can be decreased by having him observe the chart through a long tube.

A similar variation of the visual angle can be made easily and rapidly with the projected visual charts.

Thibaudet (1923) added to the subject's confusion by testing with figures constructed so that the largest figures subtended a smaller visual angle than the smaller ones. An honest person should, therefore, read the smaller figure immediately.

A mirror can be used to advantage in testing near vision. The examiner can try a simple experiment on himself by holding a card of symbols or reverse print on each side of his head in such a position that the right card is seen in a mirror only by the left eye and the left card only by the right eye.

The images are thus crossed and it is not possible to tell which eye observes the print without closing the eyes alternately. In a similar manner the person simulating blind-

TABLE 2
DIMINUTION OF ACUITY FOR SIMPLE HYPEROPIC AND MYOPIC ASTIGMATISM

Acuity	20/30	20/40	20/50	20/70	20/100	20/150
Axis (horiz.)	1.0	1.50	2.0	2.50	3.0	4.0
Axis (obliq.)	0.75	1.0	1.50	1.75	2.25	2.75
Myopia or Hypermetropia	0.50	0.75	1.0	1.25	1.50	2.0

ness may unwittingly give a better degree of vision than he had previously claimed, if he does not appreciate the crossing of the images.

If the subject claims amblyopia in one eye only, recourse may be had to several simple procedures. If the good eye is atropinized while the subject has no opportunity to experiment upon himself, his acuity for near vision is a function of his supposedly bad eye and he may reveal himself readily.

Baroffio, who first suggested this procedure, also used eserine on occasion, although atropine would seem preferable in most cases.

Gradle (1937) used three polaroid discs, 36 mm. in diameter and two-mm. thick, placed in the trial frame with the polarizing axes horizontal and two of the three discs over the good eye. He then asked the patient to read the smallest letters with both eyes open and immediately rotated the third polaroid so that the axis became vertical over the good eye for a sufficient length of time to allow the reading of a few letters.

The polaroid discs with crossed axes stop vision in the good eye and an estimate of vision in the poor eye can thus be obtained.

A similar test can be used with the projecto-chart in which a polaroid disc in the projector can be rotated by a handle. The patient, wearing polaroid glasses with one axis at 90 degrees and the other axis at 180 degrees, can read the chart with only one or the other eye as the disc in the projector is rotated.

It is, however, absolutely essential in performing polaroid tests that the patient's head remain immobile.

The use of prisms or lenses easily available to the ophthalmologist may be of value. By placing a 50-degree prism over the good eye, the image is thrown out of the field of vision and the visual acuity obtained is that of the amblyopic eye.

Harlan placed the retinoscopic findings on the amblyopic eye and a +15D. to +20D. sphere over the better eye, then coaxed the

patient to read in the hope that the patient would not appreciate the fogging of the good eye.

Jackson's test utilizes cylinders to make the fogging of the better eye imperceptible to the patient: +5.0D. and -5.0D. cylinders are placed at axis 90° over the better eye and the retinoscopic findings over the poor eye. When the subject has been able to satisfy himself that his vision has not decreased (since the cylinders neutralize each other), he is encouraged to read the Jaeger series and the cylinder axes are suddenly rotated 15 degrees apart. As the cylinders are crossed, the better eye is fogged and the acuity obtained is that of the poor eye.

A +6.0D. sphere may also be placed over the better eye and the subject encouraged to read at 17 cm., after which the print is slowly withdrawn; if the patient continues reading, he must be doing so with his poor eye.

So long as the subject claims amblyopia in one eye only, Javal's bar test, the Bishop Harman test, or the pseudoscopic tests previously mentioned may also prove of value.

Lastly, the problem of simulated bilateral amblyopia will be considered. Varying the distance from the chart with or without the use of mirrors or special equipment, varying the size of the top letter of the chart, or using charts which do not have regular size-sequence may show discrepancies in acuity (Adler, 1896; Roth, 1906; Terson, 1909; Kern, 1912; Bjerke, 1914-1917; Lindberg, 1930; and others). Thibaudet's figures may sometimes prove the simulation.

Lytton (1942) suggested the use of cylinders in the trial frame. In addition to correcting lenses, a +1.0D. cylinder axis 90° and -1.0D. cylinder axis 45° is placed over the eye tested, and the patient is asked to rotate the minus cylinder to give the best vision. If he turns it 90 degrees he is probably truthful, but a malingerer is likely to place it at 180 degrees.

In either case, the vision claimed with the cylinders crossed is no less than one half the vision without the cylinder since such a

cross-cylinder reduces acuity 50 percent.

Baudry (1897) placed +6.0D. spheres before the eyes and coaxed the patient to read at 17 cm. The patient was then told that the strength of the lens was going to be increased so that he could read the print farther away, and the plus spheres were neutralized with minus spheres. If the malingerer continued to read, a measure of his acuity might be obtained.

HYSTERIA

Brief mention should be made of hysteria which presents the greatest single deterrent to making a differential diagnosis of malingering. If the tests already outlined prove that the patient sees more than he claims, it still must be proved whether the deceit is intentional (in which case he is a malingerer) or whether it is produced by a subconscious motivation (in which case he is an hysteriac). The mere potentiality for receiving material reward does not prove intentional deceit on the part of the patient.

A knowledge of the patient's personality is essential if the examiner is to make an accurate differentiation and avoid the embarrassment of false accusation. The psychodynamics of hysteria is disputable and its interpretation varies with the school of thought to which the psychiatrist belongs.

Certain earmarks of hysteria are, however, fairly characteristic and should be sought. The "belle indifference" of the hysteriac is often striking. While the malingerer is suspicious, cautious, and unwilling to be examined, the hysteriac placidly accepts his "handicap," revels in the attention he receives, and describes his difficulties in painful detail.

The hysteriac gives a background of recurrent anxiety attacks, beginning at an early age and manifesting themselves by a

multiplicity of autonomic complaints such as palpitation, sweating, dyspnea, trembling, nausea, diarrhea, faintness, dizziness, fullness in the head, globus, and varied paresthesias.

The hysteriac demonstrates emotional immaturity—a childlike naiveté which demands attention. He is quick to make friends but his affections are changeable and he has difficulty maintaining sustained effort (marriage, job, and so forth). He often has an active fantasy life, does not tolerate daily and necessary frustrations and, when frustrated, regresses to an infantile pattern of behavior.

The complaints of the hysteriac, therefore, serve a purpose as an outlet for inner conflict, whether it be to fulfill an overpowering desire, to fulfill a wish, or to escape from some difficulty. Escape into illness is thus the life pattern of the hysterical patient.

A knowledge of the patient as a personality rather than a pair of eyes will supply the clues for the differential diagnosis of malingering and hysteria.

SUMMARY

The detection of malingering is an important problem often relegated to the ophthalmologist, since he is in the peculiar position of being able to evaluate both functional and organic complaints.

One phase of the problem—the simulation of decreased visual acuity—has been discussed and special tests which provide factual evidence to support the diagnosis have been presented.

A brief resume of the psychodynamics of hysteria has been included in order to present features of the most closely allied dysfunction.

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PSEUDOGLIOMA*

A CLINICOPATHOLOGIC STUDY OF 15 CASES

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PART I. INTRODUCTION

Following the papers of Terry,¹⁻⁷ Reese,^{8, 9} Krause,¹⁰ and Owens and Owens^{11, 12} on retrolental fibroplasia, the interest in intraocular pseudotumors in infants has been tremendously stimulated. These pseudotumors represent a variety of pathologic entities, most of them simulating in some degree retinoblastoma.

On surveying the literature of pseudoglioma, I was amazed that only one series of such cases could be found, this being reported in 1892 by Teacher Collins.¹³ Inasmuch as 15 specimens of this condition were available, it was thought worthwhile to study these cases from the standpoint of their clinical picture, their differential diagnosis, their incidence, and their pathologic classification.

The term pseudoglioma for this condition is probably as acceptable as any other. Pseu-

dotumor is too general, as about the only other tumor with which it may be confused is retinoblastoma. Although the term retinoblastoma is preferable to glioma, having gained almost complete acceptance, the term pseudoretinoblastoma seems too cumbersome, even though it has been used.¹⁴

In the strictest sense, a pseudoglioma may be defined as any other ocular condition in which enucleation is done because of the clinical diagnosis of retinoblastoma, with a subsequent histologic examination disproving this diagnosis. This, of course, implies a mistaken clinical diagnosis.

In the liberal sense, it is any intraocular lesion which is impossible to differentiate absolutely from retinoblastoma, even though it is quite probable that the lesion is not neoplastic.

From the practical standpoint, the best definition of pseudoglioma is probably that of Treacher Collins:¹⁵ "Any condition of the eye liable to be mistaken for true glioma."

It must be emphasized that the term pseudoglioma is strictly a clinical diagnosis as, after a histologic examination, a very exact

*From the Department of Ophthalmology, Washington University School of Medicine, and the Oscar Johnson Institute. Candidate's thesis presented toward membership in the American Ophthalmological Society, accepted by the Committee on Theses.

pathologic diagnosis is usually evident. As a final pathologic diagnosis, the term pseudoglioma should never be used.

The earliest detailed report on pseudoglioma is that of Treacher Collins,¹³ appearing in 1892. He found that, of the 1,020 eyes which were removed at the Moorfield Hospital in the four years, July, 1888, to July, 1892, 24 were removed because they were supposed to contain a glioma of the retina. After pathologic examination seven of these proved to be some other condition. He also reports seven other cases of pseudoglioma, making a total of 14 cases. He divided these cases into three different classes:

"1st: Those in which there is a persistence and thickening of the posterior part of the foetal fibro-vascular sheath of the lens, or an atypical development of the anterior part of the vitreous with or without persistent hyaloid artery.

"2nd: Cases in which large masses of tubercle occur in the choroid.

"3rd: Cases in which there has been inflammatory effusion into the vitreous, following a retinitis and cyclitis, and in most cases accompanied by detachment of the retina."

He found two of these cases to be in the first class, one to be in the second class, and the remaining 11 to be in the third class. After reviewing the histologic reports in his third class, it is evident that eight of these are probably due to the organization of intraocular inflammation, while the remaining three are probably exudative retinitis.

He found some ear affection in four of the 11 cases, and head symptoms, probably meningitis, in six of the 11. He believes that the connection between the intraocular inflammation and the meningitis might be either embolic, or one of direct extension along the optic nerves. His report continues to be one of the best papers available on the subject.

The latest detailed report on this condition is that of Wetzel¹⁵ who, in 1941, reported one case and thoroughly discussed the con-

dition from the standpoint of etiology, clinical findings, and diagnosis. He reported the case of a six-year-old child who had been under observation for several years because of a large choroiditic lesion. Three years after first being observed, she developed a large mass in the vitreous with severe glaucoma. The eye was removed because of the glaucoma with the clinical and pathologic diagnosis of pseudoglioma. The pathologic report is such that the true nature of the lesion cannot be determined. From a review of the individual cases in the literature, he concluded that the commonest cause of the condition is metastatic ophthalmia.

A great majority of the cases found in the literature are merely case reports of a single or, at the most, two or three cases of this condition.¹⁰⁻²² From these scattered reports a true picture of the various pathologic types and their incidence is not evident. There are a number of cases of pseudoglioma appearing in papers on the diagnosis of retinoblastoma, as case histories of both conditions are often given for comparison in differential diagnosis.^{14, 23, 24}

Some of the most interesting cases of pseudoglioma appear in various reports under the title of the final pathologic diagnosis. For instance, Reese,²⁵ in 1936, reported three cases of "Massive retinal fibrosis in children," in two of which the eyes were removed because of the possibility of retinoblastoma.

Three cases of enucleation for suspected glioma were reported by Lane²⁶ in 1919, as "Persistent posterior fibrovascular sheath of the lens."

Marshall and Michaelson,²⁷ in 1933, in a paper on "Exudative retinitis in childhood" reported four cases of this condition, all of which had enucleation because of the diagnosis of glioma.

In 1938, Lamb²⁸ reported eight cases of exudative retinitis, five of which were pseudogliomas; these five cases are included in the present report.

Recently, Klien²⁹ has described two cases

of retrolental fibroplasia, both removed as retinoblastomas. Other tumors, such as diktyoma^{30, 31} and angiomas of retinae,^{32, 33} have been mistaken for retinoblastoma.

The nature of some of these cases is completely hidden under such titles as "Histological description of an eyeball with drop-sical degeneration of the rod and cone cells" (de Schweinitz and Shumway, 1933)³⁴ and "Congenital encephalo-ophthalmic dysplasia" (Krause, 1946),¹⁰ six of the 18 reported cases having enucleation as suspected gliomas.

From a survey of the literature, the most unexpected fact noted is that, from Treacher Collins' paper in 1892 to the present, there has been no report of a series of cases of pseudoglioma studied from the clinical and the pathologic standpoints. Thus, the present series of 15 cases would appear to be not only the sole modern report, but also the largest in the literature.

Despite the relatively few cases in the literature, pseudoglioma is probably not a rare condition. Several large series could probably be gleaned from the various collections of pathologic material in this country, if they were carefully surveyed from the standpoint of the clinical diagnosis of retinoblastoma in comparison to the actual final pathologic findings.

MATERIAL

The present series of 15 cases of pseudoglioma was collected from the files of the Laboratory of Ophthalmic Pathology of the Department of Ophthalmology of the Washington University School of Medicine. From its inception in April, 1928, through April, 1949, a period of 21 years, a total of approximately 2,056 eyes were received in the laboratory. Fifteen of these proved to be

pseudoglioma, an incidence of 0.73 percent, or a ratio of 1 to 137.

Inasmuch as both the oldest patient with retinoblastoma and the oldest one with pseudoglioma were aged seven years, all specimens of children, aged seven years and under, were surveyed. There were 169 cases in this age group, a percentage of 8.2 of the total number of specimens.

In this group of children, the causes of enucleation were as follows: Trauma, 56; retinoblastoma, 62; pseudoglioma, 15; inflammatory disease, 22; and congenital defects, 13. Thus, considering the true tumors and pseudotumors as one group, the possibility of tumor was the cause of enucleation in 77, or 45.5 percent, of the eyes removed in these children.

This figure is probably artificially high, as all cases of suspected tumor are sent to the laboratory, while in cases of obvious disease, such as trauma, the globe may not be examined pathologically. The ratio of pseudotumors to retinoblastoma is 1 to 4.1. In other words, in this series, of every five cases enucleated for retinal tumor, one case was a pseudotumor.

Of the 15 cases, only five (Cases 2, 9, 11, 13, and 15) originated in the hospitals associated with this laboratory. Of the other 10 cases, four (Cases 1, 3, 5, and 7) were sent in from other Saint Louis hospitals, and the remaining six (Cases 4, 6, 8, 10, 12, and 14) from the territory surrounding Saint Louis. Five of these cases (Cases 1, 2, 3, 5, and 7) have been reported previously by Lamb²⁸ as cases of exudative retinitis.

The clinical and pathologic findings of these 15 cases, listed chronologically, are summarized in Table 1.

(To be continued.)

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TABLE 1

A SUMMARY OF THE CLINICAL AND PATHOLOGIC FINDINGS IN 15 CASES OF PSEUDOGLIOMA

Case	W.U. Path. No.	Race	Sex	Age	In-volve-ment	Birth	Presenting Symptoms	External Examination	Ophthalmoscopic Findings
1	263	W	M	1½	?	Full term? Birth weight?	Grayish white color in pupil	Normal	Behind lens is a diffuse grayish white opacity without blood vessels
2	1398	W	F	3 yr.	O.D.	Full term 7½ lbs.	Eye turns outward	A.C. shallow. Pupil irregular from posterior synechia	Large irregular gray mass without vessels behind lens
3	1460	W	F	7 yr.	O.S.	Full term Birth weight?	Loss of vision. Outward turning	Normal	Floating opacities in vitreous. Narrow grayish band extending obliquely across eye
4	2090	W	M	4 yr.	O.D.	Full term Birth weight?	Inflammation and pain	Inflamed and shrunken	Mass in vitreous
5	2099	W	M	8 mos.	O.D.	Full term 6 lbs. 13 oz.	Eyes wander. Right turns outward	Normal	Large white mass inferiorly with detachment extending to disc
6	2177	W	F	3 mos.	O.S.	Full term 7 lbs.	White spot in pupil. Inflammation and pain	Inflammation. Acute glaucoma	Lens opacity, retrolental membrane
7	2183	W	M	3½ yr.	O.D.	Full term? Birth weight?	White reflex in pupil. Outward deviation	Normal	Large white opaque mass filling vitreous
8	3426	W	M	2 yr.	O.D.	Full term 8 lbs.	Loss of vision. Slight crossing	Normal	Large white solid lobular detachment of retina, inferior temporal quadrant
9	3741	W	M	3 mos.	Bilateral	Full term 6 lbs. 7 oz.	Poor vision. Clouding pupil	Nystagmus	O.D. Large white mass in vitreous O.S. Large bullous detachment inferiorly
10	3954	W	M	4 yr.	O.D.	Full term 7 lbs. 3 oz.	Loss of vision	Normal	White mass in posterior pole with detachment
11	4267	N	F	9 mos.	Bilateral	3 mos. premature 3 lbs.	Blind. White pupil. Jerking movements	Small cornea. A.C. very shallow. Pupil fixed	O.D. Large white area in posterior pole slightly elevated O.S. Just behind lens, pinkish solid mass with vessels on surface
12	4270	W	M	4 mos.	O.D.	2 mos. premature Birth weight?	None. Condition found on admission	A.C. obliterated. Pupil dilated and fixed	Immediately behind lens is a yellowish opaque mass
13	4409	W	F	2 yr.	Bilateral	Full term 8 lbs.	Crossing right. Poor vision. Pain and inflammation	Cornea small and cloudy. Iris atrophic with posterior synechia	O.D. Large white mass just behind lens O.S. Large elevated mass in superior temporal region
14	4447	W	M	4 mos.	O.S.	Full term 8 lbs. 11 oz.	Discoloration of iris. White spot in pupil	A.C. collapsed. Large posterior synechia	Posterior segment completely filled with an opaque white mass
15	4461	W	M	3½ yr.	O.S.	Full term 6 lbs. 9 oz.	Occasional crossing. Poor vision	Normal	Inferior part of posterior pole shows white mass extending forward from region of disc

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TABLE I—Continued

A SUMMARY OF THE CLINICAL AND PATHOLOGIC FINDINGS IN 15 CASES OF PSEUDOGLIOMA—Continued

Tension	General Health	Clinical Diagnosis	Pathologic Findings	Pathologic Diagnosis
Normal	Good	Glioma	Complete detachment of retina. Diffuse edema of retina with localized area of inflammatory infiltration	Exudative retinitis
Elevated	Progressive right hemipodystrophy Multiple tumors	Pseudoglioma. Secondary glaucoma	Complete retinal detachment with folds of retina behind lens. Thin connective tissue membrane for face of retina. Localized area of gliosis in retina	Exudative retinitis, late glaucoma, secondary
Normal	Good	Intraocular neoplasm	Large localized area of retinal inflammation and proliferation with fibrous strands in vitreous. Second area of retinal folding	Massive retinal fibrosis
Soft	? Encephalitis ? Rheumatic fever	Glioma or pseudoglioma	Dense membrane of connective tissue behind lens detaching ciliary body and retina	Cyclitic membrane—organization of metastatic vitreous abscess
Normal	Rectal fistula, otherwise normal	Retinoblastoma	Retina diffusely edematous. Localized detachment in posterior pole, with area of albuminous infiltration	Exudative retinitis
Elevated 35	Good	Glioma Cataract Secondary glaucoma	Fibrous mass posterior to cataractous lens. Patent well-developed hyaloid artery. Maldeveloped filtration angle and anterior chamber	Persistence of posterior tunica vasculosa lentis. Developmental glaucoma
Normal	Good	Retinoblastoma or pseudoglioma	Complete detachment of retina with massive folds behind the lens. Diffuse albuminous edema. Localized inflammatory area near ora serrata. Localized glial proliferation	Exudative retinitis, late
Normal	Good	Inflammatory detachment or glioma	Bullous detachment in one half, flat detachment in the other. Diffuse albuminous edema of retina. Localized area of retinal inflammation	Exudative retinitis
Normal	Good. Mother had "cold" first trimester	Retinoblastoma, bilateral	Complete detachment with fibrous postlental membrane. Large granulomatous mass in vitreous and retina. Active choroiditis, posterior pole	Chorioretinitis with inflammatory detachment
Normal	Good	Retinoblastoma	Diffuse edema of retina with complete bullous detachment. Localized area anteriorly of retinal inflammation. Some hemorrhage in retina	Exudative retinitis
Normal	Good	Retinoblastoma, left. Macular lesion, right	Axial detachment of retina with subretinal hemorrhage. Folds of retina behind lens. Proliferation of connective tissue near each ora. Collapsed anterior chamber	Retrolental fibroplasia
Normal	Stuporous One convulsion	Retinoblastoma	Axial detachment with rosette mass behind lens. Thin membrane of connective tissue on surface of retina. Old hemorrhage in subretinal space. Proliferation of connective tissue near ora serrata	Retrolental fibroplasia
Elevated 26	Good	Retrolental fibroplasia or retinoblastoma, bilateral glaucoma, right	Axial detachment with retrolental membrane. Much fibrosis on and in retina. Active, choroiditis, posterior pole	Chorioretinitis with inflammatory detachment. Glaucoma, secondary
Normal	Good	Retinoblastoma or retrolental fibroplasia	Immediately behind lens is a dense connective tissue membrane detaching retina. Large mass of bloodstained connective tissue and old hemorrhage in vitreous	Cyclitic membrane—organization of vitreous hemorrhage
Normal	Good	Pseudoglioma or retinoblastoma	Two localized areas of retinal proliferation with strands extending into vitreous	Massive retinal fibrosis

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CORTICAL POTENTIAL CHANGES IN SUPPRESSION AMBLYOPIA*

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INTRODUCTION

Although suppression amblyopia has long been recognized, the cause of the condition is still in doubt. Most authorities believe suppression amblyopia, as its name implies, is due to a cortical suppression of retinal images. Other authorities believe that the retinal circulation is decreased and physiologic changes are responsible for the decreased visual acuity.

By the use of the electro-encephalogram we found that abnormal cortical brain waves are present. It is our belief that this strengthens the theory of cortical suppression.

METHOD OF INVESTIGATION

The routine procedure for obtaining an electro-encephalographic tracing was used.

* Presented before the Saint Louis Ophthalmological Society, 1950.

The procedure is described in the *AMERICAN JOURNAL OF OPHTHALMOLOGY* (**33**:1095 [July] 1950) in the preliminary report on "Cortical potential changes in amblyopia ex anopsia."

Gibbs recently reported that, if seconal or some barbiturate were given before the electro-encephalogram was taken, obtaining the tracing would not only be more simple but latent abnormalities would also be brought out. Therefore, in some of our most recent cases, seconal has been given approximately 45 minutes before the tracing was made.

CASES STUDIED AND RESULTS

Our study has been broadened to include all cases in which suppression might be present. Now being studied are 59 cases of suppression amblyopia associated with strabismus. Our findings are summarized in Table I.

Electro-encephalographic tracings have been obtained in 22 cases of alternating strabismus. When summarized (table 2), the results show a striking similarity to those found in suppression amblyopia with strabismus.

Our findings in anisometropia with amblyopia and no strabismus show a statistical pattern somewhat similar to that of strabismus cases (table 3).

Seven adults who developed heterotropia on a parietic basis are now under study. In these cases no amblyopia was present. Occasionally, diplopia would be noted by the patient. Most cases were of long duration. In no instance was the electro-encephalographic tracing abnormal.

Two cases of amblyopia with strabismus, in which the original electro-encephalographic findings were abnormal, have been completely corrected. Equal visual acuity, fusion, and orthophoria have been established. In one case the previous abnormal tracing has shown a marked change. Where the rhythm had been interrupted by long bursts of low waves, fast and slow waves are being shown in close association. This may be due to the breakdown of the obligatory reflex.

Three children in whom pathologic ocular changes produced different retinal images have been studied. In one case, eccentric fixation was present. In these cases, the brain waves were abnormal.

DISCUSSION

Our findings indicate that, in cases of suppression, abnormal waves appear before the age of five years in some cases, between the ages of five and 15 years in most cases, and then, for some reason, disappear in adults.

These findings can be correlated with the theory of Chavasse. Chavasse believes that suppression develops from a facultative active inhibitory reflex into an obligatory reflex. Apparently in the facultative stage, no abnormal waves become manifest. The abnormal tracing appears at a later period when

obligatory suppression is expected. Some change which causes the abnormal waves to disappear occurs during development into adulthood.

It is interesting that, in adults with parietic heterotropias, the abnormal waves did not occur. Amblyopia did not develop and troublesome diplopia occasionally persisted. It would appear that the reflex never develops into an obligatory one, but remains facultative.

The association of abnormal brain waves with different retinal images, due to pathologic conditions, suggests that obligatory suppression of the image occurs. This would suggest that some of the decreased acuity of such an eye might be due to suppression. Many clinical experiences indicate that this

TABLE 1
FINDINGS IN SUPPRESSION AMBLYOPIA ASSOCIATED WITH STRABISMUS

Age Group (years)	No. Cases	Abnormal EEG	Percent Positive
3-4½	4	1*	25
5-12	39	32	82
12-15	9	2	22
15-20	3	0	00
20-30	4	1†	25

* Abnormal retinal correspondence present, definite signs of suppression established.

† Borderline positive after hyperventilation.

TABLE 2
FINDINGS IN ALTERNATING STRABISMUS

Age Group (years)	No. Cases	Abnormal EEG	Percent Positive
2½-4	4	0	00
5-10	13	9	69
13-16	4	2	50
55	1	0	00

TABLE 3
FINDINGS IN ANISOMETROPIA WITH AMBLYOPIA AND NO STRABISMUS

Age Group (years)	No. Cases	Abnormal EEG	Percent Positive
5-10	7	3	43
12-14	6	4	66
15-17	3	0	00

might be true. Unless one can be sure the ocular pathologic process is sufficient to account for the decreased visual acuity, patching should be considered.

TRENDS IN THE PRESENT STUDY

It appears that, if the electro-encephalogram is abnormal, an obligatory suppression is present. Such a case should respond to occlusion therapy, but considerable time may be necessary before the visual acuity of the amblyopic eye will improve to normal or near normal.

The children who wore a patch faithfully and whose electro-encephalogram was positive have had improvement in their visual acuity. However, rarely has patching been feasible in persons over the age of 12 years. We have had, therefore, no personal experience in what would occur if these persons were to receive occlusion therapy.

Those children with normal brain-wave patterns may or may not improve with patching. We believe this may mean that either an obligatory reflex is not, as yet, present, or that an obligatory reflex is not necessary because some pathologic process

is the cause of the amblyopia.

If the obligatory reflex is not as yet established, the visual acuity should rise quickly on patching the good eye. This has frequently been the case, and a short period of occlusion often results in a marked rise in visual acuity.

SUMMARY

1. We believe our findings lend support to the theory of Chavasse that suppression amblyopia is caused at the cortical level. We believe suppression is associated with abnormal neuronal discharges in the cortex.

2. The wide distribution of abnormal waves suggests that visual perception involves widespread cortical areas.

3. Suppression may contribute to pathologic disturbances in decreasing the visual acuity of an eye.

4. Electro-encephalographic tracings may be of value for diagnosis and prognosis of cases of suppression amblyopia.

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GALACTOSE CATARACTOGENESIS*

REVIEW OF LITERATURE AND CASE REPORT

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In recent years the rare syndrome of galactosemia has assumed some importance in pediatric practice because its recognition has resulted in the cure of an otherwise obscure and hopeless condition. It is a rare and fascinating metabolic anomaly in which there is a decreased ability to metabolize galactose normally. The essential features of this syndrome include severe malnutrition, galactosuria, galactosemia, and hepatomegaly. Long-standing cases may exhibit mental retardation. Less frequently one finds lamellar cataracts. The cataracts are reversible if therapy is instituted early.

The purpose of this paper is to present

this clinical syndrome to the ophthalmic literature in the form of a case report with a critical review of the clinical literature. The case reports to date, of which there are 12, either neglect completely, or relegate to the background, the ophthalmic aspects of this metabolic anomaly. The complete reversibility of the ocular manifestations under prompt and early therapy decries this lack of interest. Of extreme interest is the parallelism observed between the experimental galactose cataracts studied in the rat and the behavior of the lenticular opacities of the infant observed in this report.

REVIEW OF LITERATURE

Table 1 presents a tabular summary of the ocular manifestations appearing in the 12

TABLE 1
GALACTOSEMIA: TABULAR SUMMARY OF THE LITERATURE WITH REFERENCE TO CATARACT FORMATION

Author	Year	Number of Cases	Age when Diagnosed	Cataract Type	Regression of Cataract
Von Reuss ¹	1908	1	8 months	?	?
Goppert ²	1917	4 siblings	1-26 months 2—died at 2 months 1-2 years, 5 months	?	?
Fanconi*	1933	1	9 years	Zonular	No follow-up
Unshelm*	1934	1		?	?
Mason and Turner*†	1935	1	6 months	Present type unknown	Treated surgically
Norman and Fashena*	1943	1	11 weeks	No mention at 5 months of age	
Mellinkoff et al. ⁷	1945	1	25 days	No mention at 7 months of age	
Bruck and Rapoport*	1945	1	1 month	Zonular	Resorbed in few weeks
Goldbloom and Brickman*	1946	2	6 months 3½ months	Nuclear Ant. cortical	Needed at 6½ years Slight regression at 9½ months
Greenman and Rathbun ¹⁰	1948	1	18 weeks	Nuclear	Incomplete regression at 7 months
Goldstein and Ennis ¹¹	1948	1	2½ months	Zonular	Complete resorption
Bell et al. ¹²	1950	2 siblings	1-8 days died 1-8 days	0	0

* Cataracta zonularis present in two other siblings without symptoms of galactosemia.

† Personal communication mentioned in paper of Bruck and Rapoport, 1945. Original paper contained no mention of ocular condition of patient.

reports on galactosemia in the literature. Where question marks appear, or information is scanty or indefinite, it is a reflection of a lack of adequate study of the eye manifestations, present or absent, in the patients reported upon. The older foreign literature is incomplete and is included in order to show the total number of reported cases.

Mason and Turner⁵ in 1935, Norman and Fashena⁶ in 1943, and Mellinkoff and others⁷ in 1945 do not mention cataracts in their patients. It is not until the paper of Bruck and Rapoport⁸ in 1945 footnoted the personal communication from Mason and Turner reporting cataracts discovered too late for publication that we find the consistent appearance of cataracts in all subsequent papers.

Thus, with the exception of Fanconi's case¹³ in 1933, where the presence of zonular cataracts without galactosemia in two other siblings renders the etiology questionable, the first human association of galactosemia with cataracts appears in the report of Bruck and Rapoport⁸ in 1945.

All cases reported subsequently had either permanent or transient lenticular opacities with the exception of the two siblings discussed by Bell and others¹² in 1950, where the first sibling died at eight days of age with hepatic changes, and the second child born three years later was discovered to have galactosemia at the same age. Prompt introduction of therapy no doubt prevented the occurrence of cataracts in the second infant, who lived.

Insufficient data prevent generalizations. Nevertheless, it can be stated roughly that diagnosis and vigorous treatment of the disease before two to three months of age may be expected to result in complete resorption of any lenticular opacities present. Cases discovered after three months of age apparently give a guarded prognosis as to complete regression of existing cataracts.

Knowledge of the effect of galactose on lenticular tissue has been known since 1932

when Kirby and others¹³ made the important observation that galactose had a direct toxic effect on lens epithelium cultivated *in vitro*.

In rats, an effect of lactose on the crystalline lens has been known since 1935 when Mitchell and Dodge¹⁴ reported that cataracts developed in all rats that received a 70-percent lactose ration. In subsequent studies Mitchell¹⁵ found that galactose was the responsible factor in the diet. The animals had persistently elevated blood-sugar values and galactosuria. No pathologic changes other than those in the eyes were noted either *in vivo* or on postmortem examination.

Lenticular changes developed most readily in young rats, which may indicate that the young lens is more easily injured than the old one by chemical changes in the surrounding medium. These workers showed definitely that diminished dietary protein shortened the time of development of cataracts from 26 to 15 days. Increased dietary cystine had a lesser but similar effect.

Cataractous changes observed by Mitchell¹⁵ generally followed this pattern. As early as the fifth day in a rapidly developing change one observes a narrow, dense shadow in the equatorial region. This increases rapidly by the eighth to 12th day to cover from one half to seven eighths of the anterior cortical region.

By the 14th day this anterior cortical "film" breaks up into scattered transparent vacuoles. The vacuoles become less dense and more scattered and, by the 20th day, permit observation of opacification in the posterior cortical and nuclear regions of the lens. Depending upon the galactose content of the diet, dense nuclear and cortical opacification results in from 21 to 60 days from the start of the experiment.

Regressive changes occur in every case of complete, dense, combined nuclear and cortical cataractous change in which resumption of a normal diet is initiated within some 30 days from the time of appearance of visible lenticular changes. This is observed from

29 to 70 days after the normal diet is commenced and consists essentially of a clearing of the cortical opacity.

In rare instances in which the lesion did not progress to the stage of complete opacity, the lenses became completely clear except for a pinhead nuclear opacity barely visible to the naked eye. Prolonged feeding of the aggravating factor may decrease the speed or the extent of the regression possible.

Gifford and Bellows¹⁶ presented an excellent study of the histologic changes in the lens produced by galactose. They showed that the earliest changes involved the liquefaction of cortical fibers near the equator, but the growth of new fibers was rapid enough so that some relatively normal fibers were always found just beneath the capsule in this region.

The capsular epithelium showed changes later. The nuclear region remained undamaged to a late stage. With resumption of a normal diet regeneration of new fibers occurred rapidly.

Resorbed cataracts appearing clear ophthalmoscopically were shown to have histologic changes in sectioning. Degenerated fibers were found just outside the nucleus, apparently pressed toward the center of the lens by a layer of newly formed microscopically normal fibers.

Biochemical changes in the lens following galactose administration have been studied but add little to the understanding of galactose cataractogenesis. None of the changes are specific for galactose-produced cataract. They are believed to be manifestations of tissue senescence and death; similar to what occurs in senile cataract.⁹

Swan and others¹⁷ demonstrated an increase in total ash with more sodium, calcium, sulfate, and carbonate, but less potassium, phosphate, and chloride. The water content increases as does the anions more than the cations.

Bellows¹⁸ showed that galactose causes a loss of glutathione, cystine, and vitamin C

from the lens. The reduction of the sulfhydryl and vitamin-C content precedes any sign of cataractous change.

There is a marked loss of glutathione in the cortex in early stages while a normal amount is still present in the nucleus. In the stage of mature cataract glutathione is also lost from the nucleus.¹⁰ There is a loss of oxidation-reduction systems and a decrease in metabolic activity as demonstrated by a rise in electrical potential in the central portion of young rat lenses.²⁰

Subcapsular vacuoles are seen in large numbers in cases of true human diabetic cataract in the young.²¹ They are thought to be characteristic of this etiology. It is suggestive that lens changes in these cases of human diabetic cataract are equivalent to the much more massive vacuolar changes in the experimental cataracts due to galactose, zylose, and in the diabetic rat.²²

High concentrations of galactose and dextrose decrease the permeability of the lens capsule, the effect being greater with galactose since it is not readily metabolized.²³ Intravenous injection of hypertonic galactose solutions, among various substances tried, produced opacities of the lens in rats.²⁴ These began with subcapsular cloudiness and progressed to separation of the lens fibers, occasional water fissures, and, in some cases, vacuoles.

When the animal survived, regressive changes were noted following the cessation of the injection. Similar cataractous changes were produced by the injection of hypertonic 10-percent sodium chloride.

Determination of the osmotic pressure in this instance showed increase in the blood, aqueous humor, and spinal fluid directly in proportion to the rise in the sodium and chloride content of these fluids. Pertinently, this raises the question of the relationship between galactose cataract and the effects of galactose in the aqueous humor; both in regard to direct toxicity and osmotic pressure increase.

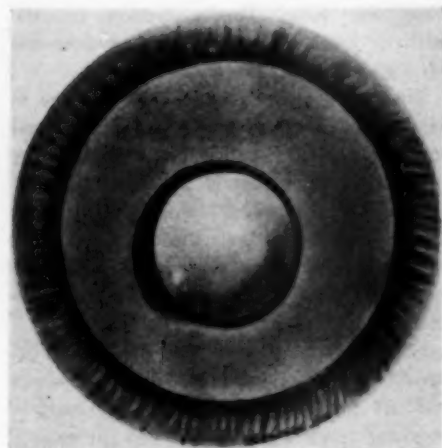


Fig. 1 (Reiter and Lasky). Artist's conception of ophthalmoscopic appearance of cataracts when patient was seven and one-half weeks of age.

CASE REPORT*

History. This seven-weeks-old white male infant was first admitted on the 10th day of life with a three-day history of vomiting, irritability, fever, and jaundice. At that time a three-plus cephalin flocculation test was reported.

The physical examination revealed an enlarged liver, impetigo, and oomphalitis. The patient was discharged improved on the 22nd day of life with the diagnosis of sepsis of the newborn. No ophthalmic examination is recorded at this time.

The child was readmitted four weeks later, aged seven weeks, because of failure to gain weight, irritability, swelling of the abdomen, generalized edema, and glycosuria. Bilateral lenticular opacities were first noted immediately prior to the second admission.

The birth history disclosed an uncomplicated pregnancy terminated by a full-term delivery with low forceps under caudal anesthesia. The birth weight was eight pounds, 10 ounces. The general condition of the child prior to the first admission was

good. The family history is noncontributory.

The physical examination revealed an acutely ill child with generalized edema, ascites, and an enlarged liver and spleen. The eyes and their adnexa were normal except for bilateral lamellar cataracts. The opacities were round, thin, and well demarcated. They delimited the lens into a nuclear and a peripheral portion, each of which was perfectly transparent. This is illustrated in Figure 1.

Laboratory examination. The urine contained four-plus sugar, no acetone, and there was a trace of albumin. The hemoglobin was 57 percent (14.5 gm. = 100 percent) and the red cell count 3.15 million. The white cell count was 13,450 with 32 percent neutrophilic leukocytes, one percent eosinophilic leukocytes, five band forms, and 61 percent lymphocytes.

The Van den Bergh test was within normal limits. The blood sugar was 93 mg. percent and the blood urea nitrogen 10 mg. percent. The cephalin flocculation was 4+. The total protein was four percent, with the A/G ratio, 1.4. The total cholesterol was 145 mg. percent, with the free cholesterol 98 mg. percent. The serum phosphorus was 6.4

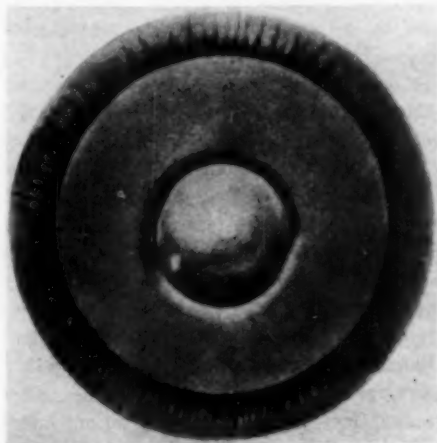


Fig. 2 (Reiter and Lasky). Artist's conception of ophthalmoscopic appearance of cataracts when patient was nine weeks of age.

* From the Department of Pediatrics, The Jewish Hospital of Brooklyn.

mg. percent and the alkaline phosphatase, 15.8 units.

It was determined that the urine sugar was nonfermentable. The mucic-acid test determined that the urinary sugar and a fraction of the blood sugar were galactose. Various determinations of the galactose content of the blood gave values as high as 43 mg. percent on admission, to the low point, 12 mg. percent, on discharge.

Cultures of the nose, pharynx, and blood were negative for pathogenic organisms. X-ray studies of the long bones, skull, and chest were within normal limits.

Flat-plate radiographs of the abdomen demonstrated distended loops of lesser and large bowel with no specific pattern. Barium studies of the large and small intestines showed no pathologic findings.

Sugar tolerance studies were very revealing. There was an increased tolerance to glucose. Following the ingestion of 10 gm. of glucose by mouth the fasting blood glucose went from 60 mg. percent to a high of 110 mg. percent in one hour and was back to 87 mg. percent in two hours. The child showed markedly decreased tolerance to galactose in that the oral ingestion of five gm. of galactose resulted in a rise of the fasting blood galactose level from 12 mg. percent to a stationary level of 119 mg. percent after two hours.

Course. The infant was placed on a diet consisting mainly of nutramigen and mulsoy, with all milk and milk products eliminated. Symptomatically many small blood transfusions were administered.

In 15 days the cephalin flocculation test was reported as negative. The edema rapidly diminished and, after an initial loss of weight due to diuresis, the child commenced to gain weight slowly. The urine was cleared of sugar in six days. The blood galactose decreased to 12 mg. percent. The total protein rose to 8.2 percent on discharge.

Gradually, in a period of several weeks, the child assumed the appearance of a nor-

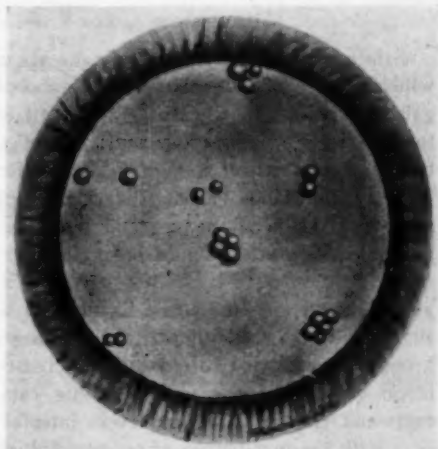


Fig. 3 (Reiter and Lasky). Artist's conception of ophthalmoscopic appearance of cataracts when patient was ten and one-half weeks of age.

mal infant of his age with increased cheerfulness, greatly diminished irritability, and increased appetite. Parallel to the improvement in the systemic condition of the infant the lenticular opacities were observed to go through a slow resorption to complete transparency.

Figure 1 shows the initial appearance of the cataracts; one and one-half weeks later the appearance is that illustrated in Figure 2. At this time the lamellar opacity is more diffuse, with the peripheral lens being somewhat less transparent than the nuclear portion. The nuclear portion remains perfectly clear.

Three weeks after the initial observations as shown in Figure 1 the appearance of the cataracts was as depicted in Figure 3. The lenses as a whole were somewhat less transparent and there were clusters of small, round, and oval vacuoles in the cortex near the equator.

Eight weeks following the initial observation of the cataracts, the lenses were perfectly transparent with no evidence of the preceding opacities visible through the ophthalmoscope. No slitlamp examination was performed.

DISCUSSION

Galactosemia is truly a systemic disease in which an inborn inability to metabolize galactose results in a wide derangement of the normal physiology. In contradistinction to the rat, in which a high galactose diet causes a high blood galactose level resulting in cataractous lens changes and little else, galactosemia in the human being deranges the body economy by affecting, in some as yet unknown way, the entire metabolism of sugar. Thus, in the human, the changes brought about are twofold—(1) Increased blood galactose levels with resulting cataracts and (2) more or less severe interference with the metabolism of sugar resulting in malnutrition, liver involvement, glycosuria, and associated signs and symptoms.

This child exhibited the full-blown typical clinical picture. The rapid alleviation of the symptomatology and regression of the signs to normal on elimination of milk and milk products from the diet is classical.

The cataracts were first observed at seven and one-half weeks of age. Preceding stages in their development were lost to our observation. Three stages of sharp, lamellar opacities at seven and one-half weeks of age, spreading lamellar opacities at nine weeks, and cortical vacuoles at ten and one-half weeks of age are in accord with the published observations of galactose cataracts in the rat already discussed.

As far as we are aware this is the first instance of correlation between the human and rat galactose cataract. Some eight weeks following the initial observation, the lenses were completely clear to ophthalmoscopic

observation. This is in contradistinction to observations with the rat, where complete regression is not recorded. Perhaps the blood levels of galactose obtained in the experimental rat are much higher than were obtained in our patient on a comparable basis.

Human cases remaining undiagnosed for over three months appear to have cataracts which do not regress completely, if at all. Mitchell¹⁴ has shown the importance in the rat of the dietary level of galactose and the duration of the experiment on the regression of the lenticular opacity. The higher the galactose level and the longer the duration of the experiment the slower and less complete is the regression.

Table 1 demonstrates the importance of the duration of untreated human galactosemia in the regression of cataracts; treatment after three months is unlikely to cause complete regression, but treatment before three months' duration of the disease is most likely to give complete regression of cataractous changes.

SUMMARY

1. The clinical and experimental aspects of galactose cataracts, both in the rat and human, are discussed. Their inter-relationships and similarities are emphasized.

2. A case report of an infant, aged seven and one-half weeks, with classical galactosemia and bilateral cataracts is presented.

3. A striking similarity between the evolution of experimental galactose cataract in the rat and that of the lamellar cataracts of the infant reported upon is demonstrated.

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OPTIC NEURITIS*

A 15-YEAR STUDY

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During the past 15 years, 240 patients with optic neuritis have been under my care. It seemed worth while to review the etiology of these cases, some of which it had been possible to follow for many years. So-called tobacco-alcohol amblyopia, which is probably a nutritional disease, is excluded from consideration in this report.

The differential diagnosis must exclude:

1. Pseudopapilledema. Retinoscopic examination and refraction are always indicated. Unnecessary brain operations have infrequently been performed by neurosurgeons

on patients with high hyperopic or astigmatic refractive errors. These patients had pseudopapilledema.

2. Brain tumor. The visual fields are the most important of all the ophthalmic tests in this condition. Any defect stopping at the horizontal or especially the vertical midline suggests an intracranial lesion. A tumor pressing on one optic nerve may cause merely a central scotoma so that in all patients with optic-nerve disease the possibility of tumor must be considered.

A few symptoms of special interest are:

1. Pain in the head, usually on the same side over or behind the eye (23 percent of my patients complained of this). Sometimes this pain first occurred on the day of visual impairment but more frequently the pain

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came before the visual loss—usually a day or two preceding, but sometimes even two to four weeks before visual impairment. Frequently the patient mentioned an ache around or behind the involved eye.

2. Sixteen percent of my patients had tenderness to palpation of the globe.

These two symptoms—pain on movement of the eye and tenderness to palpation—are important. They point toward a diagnosis of optic neuritis; they point away from a diagnosis of brain tumor: Occasionally the patient comes to the ophthalmologist before the loss of vision merely because of the pain either on movement of the globe or located around the eye. Often pain is elicited only when the eye is moved in one direction.

The clinical course and treatment vary somewhat with the etiology. In this series only nine out of 240 cases had disease of structures adjacent to the optic nerve (table 1).

The orbital cellulitis in two patients was secondary to erysipelas and it resulted in optic atrophy.

Two patients had severe purulent sinusitis and one an osteitis of the bony optic canal. This apparently resulted in a direct extension of the infection to the optic nerve and a complete optic atrophy on that side. In three other patients sinusitis was probably the cause of the optic neuritis.

TABLE 1
DISEASES OF ADJACENT STRUCTURES

Orbital cellulitis.....	2
Sinusitis.....	2
? Sinusitis.....	3
Osteosclerosis of skull.....	1
? Chronic tuberculous meningitis.....	1

TABLE 2
INFECTIOUS DISEASES

Lues.....	2
Upper respiratory infection.....	3
Influenza.....	3
Mumps.....	1
Vaccinia.....	1
? Focus of infection.....	2
Encephalitis after mastoidectomy.....	1

Even 15 years ago most ophthalmologists realized that sinusitis was not a common cause of optic neuritis; at the Neurological Institute in New York and in similar hospitals, where many patients with multiple sclerosis were treated, the ordinary history from such a patient was that the sinuses had been opened two, three, four, or even more times, depending on the number of attacks of retrobulbar neuritis.

Examination of the sinuses is indicated and if infection is present it should, of course, be treated. It is, however, a relatively infrequent cause.

Infectious diseases, usually generalized, which were etiologic factors are shown in Table 2.

Lues is, of course, the most common cause of optic atrophy and a blood test for syphilis is always indicated. A retrobulbar neuritis with a central scotoma and normal peripheral fields due to lues is not common in my practice.

Upper respiratory infection coincided with loss of vision in three patients. Neurologists find that, in patients with multiple sclerosis, a recurrence of another attack sometimes occurs during an upper respiratory infection. In the patients herein reported there was, however, no evidence of multiple sclerosis over a period of many years.

Likewise after the virus diseases of influenza, mumps, and vaccinia the optic nerve may be involved. Several influenza patients had a mild myelitis as well as the optic neuritis. One influenza patient, whose optic neuritis had improved, received from her family physician an injection of influenza vaccine four months after the first loss of vision. Two days later the vision in that eye again became blurred but improved in two weeks.

It is difficult to evaluate the role of foci of infection but I think all definite infection should be eliminated. Probably such foci infrequently are a direct cause of the neuritis but their elimination may be a factor in putting the patient in best possible health.

Pernicious anemia (table 3) caused two cases. In one patient, aged 83 years, calcification of the internal carotids was present by X ray, the retinal vessels showed arteriosclerosis, a red blood count indicated about four million cells. His condition was diagnosed as arteriosclerotic optic atrophy. Three years later he returned. Another red blood count showed 2,500,000 cells. The diagnosis was pernicious anemia. He received vigorous liver treatment and, to my surprise, the vision increased from: O.D., 6/200; O.S., 4/200; to O.D., 20/50; O.S., 20/70; although the vision had been markedly impaired for three years.

Blood loss accounted for two cases. When first seen three days after a severe hematemesis associated with a duodenal ulcer one patient (fig. 1) had elevated discs with a few retinal hemorrhages near the disc. The red blood count was 1,010,000 and the hemoglobin 22 percent.

Both the neuritis associated with primary or secondary anemia and that due to blood loss might be considered nutritional in origin, but the cases listed under that heading were those of patients on very poor diets. If the diet had continued for several years, as was the case with the American prisoners of war held by the Japanese, recovery usually did not occur. In the milder cases, however, recovery does take place on treatment with a good diet or even vitamin-B complex added to the inadequate diet.

Carcinoma may metastasize to the optic nerve or to adjacent structures which infringe on the nerve and interfere with its function. In the case listed in this series there was sudden loss of vision in one eye. The

TABLE 3

NONINFECTIOUS CONDITIONS

Pernicious anemia.....	2
Blood loss.....	1
Nutritional (probably deficiency of vitamin-B complex).....	3
Trauma.....	1
Metastatic carcinoma (breast).....	1
Allergy.....	2
? Allergy.....	3



Fig. 1 (Carroll). Optic neuritis following loss of blood in a patient with duodenal ulcer.

nerve gradually became atrophic. The patient was known to have generalized carcinomatosis and the X-ray films showed a lesion near the bony optic canal.

Allergy as a cause of optic neuritis presents a controversial subject. How many patients diagnosed as having multiple sclerosis actually have an allergy of their nervous system? During this entire 15-year period at least two of our most eminent neurologists in New York have felt that allergy was a common cause of retrobulbar neuritis. They believe that many patients with the diagnosis of multiple sclerosis actually have multiple recurring neurologic lesions due to their allergy.

This was such a hopeful approach that I have asked, and I still think it is important to ask, every such patient about allergy. However, in this series there were only five patients in whom the relationship between allergy and optic neuritis seemed reasonably definite. One patient was sensitive to pork, another to turkey; one girl, not in this series, had several attacks of optic neuritis after eating chocolate; a man had a severe reaction to tetanus antitoxin and then optic neuritis.

Toxic agents accounted for seven cases (table 4). Methyl alcohol poisoning is apparently best treated with large doses of alkalis given by mouth and intravenously.

Thallium intoxication causes a peripheral neuritis, encephalitis, and loss of hair, as well as optic neuritis. In my patient the thallium

TABLE 4
TOXIC AGENTS

Methyl alcohol.....	2
Thallium.....	1
Spinal anesthesia.....	2
? Lead.....	2

was being used as an insecticide by an army physician in his apartment. The physician and his young child began to lose their hair, his wife developed optic neuritis, encephalitis, and loss of hair. Since thallium looks like table salt, it is presumed that their cook, by mistake, used the thallium in the cooking. BAL (British antilewisite) is probably of value in the treatment.

Both patients with retrobulbar neuritis following spinal anesthesia had paralysis of the sixth nerve and both recovered without treatment.

One surprise was that 19 patients were found to have Leber's disease (table 5). They were members of 14 apparently unrelated families. Many of these patients had had almost every known laboratory test but had not been questioned thoroughly regarding their family history.

As Falls⁷ has stated, most patients, when being asked whether anybody else in the family has "eye trouble," reply "no" before the question is finished. Therefore, the oculist must ask more specific questions. Were there any uncles or cousins who had poor vision even with glasses? If the answer is no, the patient is asked to talk to other

TABLE 5
LEBER'S DISEASE
(eight percent)

Number of patients.....	19
Number of families.....	14

TABLE 6
VASCULAR DISEASES

Arteriosclerotic.....	14
Hypertensive.....	8
? Arteritis.....	5
Unclassified.....	3
Rheumatic heart disease.....	1

members of the family and is questioned again on the next visit.

Leber's disease may come on at any age and in either sex. In one patient the onset was at the age of 56 years. In several other members of his family poor vision had been present as long as they could remember—and must have been present since early childhood. The final vision even in members of the same family may vary from 20/30 in one patient to ability to count fingers eccentrically in another patient; but no patient in my series is completely blind.

Some of these patients have realized that their eye condition was hereditary and have refrained from having children. The defect is transmitted through the female¹ but affects the male much more commonly.

Vascular disease (table 6) is becoming a more common cause of optic nerve involvement because more people now live to an older age.

Arteriosclerosis of the vessels supplying the optic nerve seemed to be a factor in 14 cases. The average age of these patients was 69 years. They all had a sudden loss of vision, usually in one eye. The disc sometimes appeared normal at first. More frequently, it was elevated and a few hemorrhages were often present near the disc.

Sometimes there is a loss of either the upper or lower half of the visual field. Occasionally there is some improvement in function after a few days. Part of the initial visual defect may be due to edema and, when this subsides, vision improves. On the other hand, the condition may progress. One elderly lady was seen by me soon after losing the lower half of the visual field; by the following day the upper half had also disappeared.

Excluded from this series is arteriosclerotic optic atrophy, a common condition, which progresses slowly. It frequently is accompanied by deep cupping of the disc and the clinical picture is very different from the acute process.

The evaluation of therapy is difficult. In

early cases anticoagulants may be of value, if the patients' general condition warrants this treatment. It is hoped at least to prevent extension of the arteriosclerotic obliterative process, if only part of the field is lost. Here, also, one is never sure that the process would not have stopped without treatment. Intravenous histamine, as well as anticoagulants, heparin first followed by dicumarol, has been tried in a few patients.

A sufficient number of patients have not been treated with anticoagulants to permit an evaluation of the results. Usually, however, the prognosis for return of vision is poor. Vascular spasm as well as organic changes may be present so that vasodilators should be given with some caution to patients of this age group. Diabetics seems to get similar vascular changes at an earlier age. Patients with hypertensive vascular disease also develop vascular diseases of the optic nerve at an earlier age; the average age was 54 years in this series.

Smith and Greene² in an excellent paper on temporal arteritis mentioned that a high percentage of these patients had visual disturbances, presumably an arteritis of the vessels supplying the optic nerve or the retina. Patients with this condition have a widespread arteritis and, at autopsy, the process has been found (in different individuals) in nearly all parts of the body.

Bruce,³ in a review of 34 such patients with visual impairment due to temporal arteritis, found that 18 percent had occlusion of the central retinal artery or its branches which could be seen with the ophthalmoscope and 37 percent had what he termed "ischemic retrobulbar neuritis."

I have tentatively put five of my patients in the arteritis group even though they had no evidence of temporal arteritis. All had bilateral involvement—one eye usually being affected within a few days, or at the most a few weeks, after the other. Final vision was nil in each eye in three cases. The best final vision was 20/70 in one eye. The sedimentation rate was increased; the white blood

count elevated; head pain lasting many months was common.

In the unclassified group are three patients whose optic nerve vessels apparently were congenitally abnormal and who developed occlusions at an early age. In one patient, sheathing of a small vessel corresponding to the field defect could be seen. The second patient developed a central altitudinal scotoma in one eye and, six months later, in the other eye (this has been stationary for five years). The third patient, at the age of 31 years, had a sudden decrease in vision in one eye and was told at that time that he had a "hemorrhage into the optic nerve"; 24 years later, the vision in the other eye became blurred; he had pain on movement, tenderness to palpation, a central scotoma breaking through to the periphery, and a slightly elevated disc. Vasodilators were of no value and final vision was 1/200 in each eye. The symmetry of optic nerve lesions is of great interest. A congenital vascular abnormality of the nerve manifesting itself years after birth is one possible explanation of such an unusual case.

Multiple sclerosis (table 7) is undoubtedly one of the most common causes of retrobulbar neuritis; 46 patients in this group were diagnosed as having this disease by one or more neurologists. The average age of these patients was 26 years; whereas the average age in the group with vascular disease was 61 years.

An additional 24 patients were thought to have multiple sclerosis; this group had at least three disseminated neurologic lesions but the neurologist did not feel positive of the diagnosis.

TABLE 7
MULTIPLE SCLEROSIS
(32 percent)

	No. of Cases	Percent
Multiple sclerosis.....	46	19
? Multiple sclerosis.....	24	10
Neuromyelitis optica.....	7	3

Numbness, especially in the extremities, is often present and I always ask about this. Sixty-four patients under the age of 50 years admitted numbness when they were questioned about it; only seven over the age of 50 years had this symptom. It suggests, but is not diagnostic of, a disseminated disease, especially if it recurs. There is a definite disease characterized by recurring attacks of retrobulbar neuritis and recurring attacks of numbness. Frequently the neurologic examination is otherwise negative. Some of these patients over a period of five to 10 years at least, develop nothing more; some, however, develop unquestionable multiple sclerosis.

Examination of the spinal fluid has usually not been helpful. Among 100 optic neuritis patients having spinal-fluid examination, 85 were negative, 13 had increased protein, one had increased cells, two had the parietic type gold sol with a negative Wassermann. The gamma globulin ratio may prove more valuable.⁴

In evaluating therapy in the treatment of the optic neuritis associated with multiple sclerosis, or unassociated with any recognized disease, it is most important to know the normal, or better average, course of the disease without treatment. Only a few such patients are available because it is normal for the patient to want treatment and it is normal for the physician to give some medication.

Our control series then is limited to clinic patients who were being sent around to various departments for one examination after the other in search of an etiologic factor. During this time, they often were given no treatment by the eye department and, during this period, they often improved considerably. After the onset of blurred vision, the sight frequently gets worse over a period of one or more days, remains almost stationary for a period, and then usually begins to improve regardless of therapy.

There is no specific therapy for multiple sclerosis and many neurologists⁵ feel that

we cannot expect any treatment for an acute attack once the attack has begun. Intravenous typhoid therapy is thought by some ophthalmologists to be of considerable value; whereas, some neurologists⁵ believe it can be harmful. I have not observed any definite harm to the optic nerve from typhoid treatment but neither am I convinced that it has been helpful. This treatment has been abandoned by our neurologic department but some of our ophthalmologists use it. Certainly its value in acute iridocyclitis is out of all proportion to any value it may have in optic neuritis.

Intravenous histamine given according to the technique of Horton⁶ was used in only a few cases and no changes were observed which might not have occurred without such treatment.

A recent patient, aged 30 years, developed complete loss of vision in one eye which lasted 10 days. In spite of intravenous typhoid and intravenous histamine no improvement took place. All treatment was stopped except for placebos and, within four weeks, the vision returned to 20/30.

It is well to remember that some patients improve spontaneously many months after the acute attack. A few patients show no improvement for 11 or 12 months and then have a return to almost normal vision. Dr. Horton has treated some of his patients daily for 200 to 300 days with intravenous histamine. In attempting to evaluate this therapy it is important to know that recovery may occur spontaneously after this length of time.

From a practical point of view what should the ophthalmologist do with a patient, for example between 20 to 40 years of age, who gets retrobulbar neuritis for the first time? Hospitalization is often desirable. The patient and his family are frequently alarmed by the loss of sight and rest in a hospital seems beneficial. While the patient is there all possible causes of the disease are carefully considered. Accurate field studies are repeated. A neurologist and an internist examine the patient. The patient's questions are

answered honestly but in such a way as not to add new fears; for example, he is never told that he "might have multiple sclerosis"; such a careless four words may cause years of worry and apprehension.

The ophthalmologist almost never has to tell the patient that he has multiple sclerosis. The tactful neurologist, if asked by a patient with multiple sclerosis whether or not he has it, may well in turn ask the patient—"what is your idea of multiple sclerosis?" Usually the patient's conception of the disease is very distorted and the neurologist may often be honestly reassuring.

The patient is placed on a good diet, is advised to rest as much as possible, and receives sedatives if this is impossible. If the cause is not found, I treat the patient rather than the disease. If the patient is a tense individual with many problems, I attempt to make him give up some of his work and live a more normal life.

While in the hospital the patient frequently receives intramuscular injections of liver or vitamin B₁₂. Orally, he takes vitamin-B complex capsules several times daily as well as polyvitamin capsules. If the basal metabolic rate is not over plus 10, he often

receives thyroid extract, one-half grain up to several grains daily, depending on his reaction to this. If the hemoglobin is under 100 percent, he receives iron as well as liver. If there is any suggestion of allergy he receives antihistamine drugs, most of which are sedatives. Incidentally, it is interesting that the antihistamines seem to be as satisfactory in treatment as histamine.

Perhaps all this medication should be considered as placebo treatment—and I think this is possible. Both patient and doctor want some treatment, however, and, up to now, I know of none better. Put the patient in the very best possible health. This may mean a vacation followed by less work on his return. Each patient is a different problem. Individuals who have had repeated attacks over the years are not hospitalized with each attack.

In the unknown-cause group there seem to be several different entities.

First, there are patients whose course exactly resembles that of Leber's disease, except that there is no family history of this. These patients are usually men who develop optic neuritis in both eyes, often within a few days or weeks of each other. They show very little if any improvement in their eye condition but they never develop multiple sclerosis, even though followed for years.

Second, there are young or middle-aged patients whose vision rapidly becomes nil or almost nil in both eyes at the same time (table 8). The discs are usually elevated. A few of these patients will develop acute spinal-cord symptoms and then the picture of neuromyelitis optica will be obvious. A few will have multiple sclerosis but most of them, in my experience, have one attack and no other neurologic involvement.

It is important not to let the neurosurgeon operate on such patients. I know of several cerebral decompressions and explorations which have been performed and they have shown nothing and been, of course, of no value. Often the vision improves spontaneously. In children, especially, an upper

TABLE 8
VISUAL IMPROVEMENT IN CASES HAVING COMPLETE
LOSS OF VISION

Case	Eye	Vision	Final Result
1	R	nil	20/20
	L	l. percep.	20/15
2	R	nil	20/30
	L	h. motion	20/30
3	R	nil	nil
	L	nil	nil
4	R	nil	1/200
	L	nil	20/20
5	R	nil	1/200
	L	nil	2/200
6	R	faulty l. projection	20/30
	L	nil	20/30
7	R	nil	20/40
	L	nil	20/30

respiratory infection often precedes the loss of vision and recovery is frequently good. In seven adults who had nil or almost nil vision in each eye, five recovered good vision after conservative treatment.

SUMMARY

An analysis of 240 cases of optic neuritis showed that they could be divided into three groups (table 9). In the first group (one-third) the condition was associated with diseases of adjacent structures, toxic agents, generalized infections, or noninfectious conditions, Leber's disease, and vascular disease. In the second group (one third) optic neuritis was due to multiple sclerosis or allied neurologic disorders. The causes in the last group were unknown. Some patients in this latter group will develop multiple sclerosis but many will not and certainly patients are not helped by being told that they "may have multiple sclerosis."

This disease will be conquered and it is very possible that ophthalmologists may play an important role in its conquest. Numerous lines of investigation are ahead of us. Blood sludging is being studied in relation to sudden tinnitus and deafness by Dr. Edmond P. Fowler, Jr., in the otology department.

TABLE 9
SUMMARY OF 240 CASES

	Percent
Diseases of adjacent structures.....	3
Infectious diseases.....	5
Noninfectious diseases.....	6
Toxic agents.....	3
Leber's disease.....	8
Vascular disease.....	13
Multiple sclerosis.....	19
? Multiple sclerosis.....	10
Neuromyelitis optica.....	3
Unknown etiology.....	30

Such a mechanism might possibly cause optic neuritis. Allergy of the nervous system needs much study. Our knowledge of vascular disease will increase tremendously.

ACTH and cortisone will be investigated. The endocrines will receive more attention than the vitamins; the deficiency diseases will be considered chiefly internal rather than external—that is, not due to lack of the proper foods taken by the patient but failure within the system to manufacture the proper substances for their utilization. In the next 15 years great progress will be made. I have tried merely to survey our present knowledge of this subject.

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TRANSVERSE FURROWS OF THE NAILS AS A DIFFERENTIAL DIAGNOSTIC MARK IN CENTRAL SCOTOMAS*

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The etiology of central scotomas when there are no objective findings in the eyes (retrobulbar neuritis) can show considerable variation. In the main, one must distinguish between central scotomas caused by diseases of the central nervous system (such as cerebral tumors, demyelinating processes, multiple sclerosis) and central scotomas appearing in consequence of general affections and disturbances of assimilation provoked by malnutrition.

As far as I know, changes of nail growth have not, as yet, been used as a differential diagnostic means in retrobulbar neuritis. In other diseases, however, they have been known as a distinguishing mark for a long time. Concave nails (coilonychia) point to an anemia, especially from want of iron; heavily curved nails are considered typical of phthisis.

A transverse furrowing of the nails is regarded as a mark of a severe general trophic disturbance. These transverse furrows of different breadth and depth appear on each nail. Since an individual disposition seems to be necessary for their appearing, such nail furrows are not, however, a regular symptom. Being easily visible, these nail furrows are a convenient diagnostical means, especially in retrobulbar neuritis.

In this disease the ophthalmologist is grateful for each objective symptom. The nail alterations support the diagnosis of a nutritional amblyopia. Even after all the other signs of dietary deficiency have disappeared, these transverse furrows still reveal its former existence. In a state of a general dystrophia, hair and nail growth are considerably slackened; therefore, the nail varia-

tions are often perceptible for more than six months.

A nail grows about 0.1 mm. a day. The length of the covered part at the nail root amounts to three to four mm. Thus, a pathologic variation of nail growth appears from behind the nail root after 30 to 40 days. In the course of further nail growth, the transverse furrow passes the whole nail and reaches its free edge after five to six months. The furrowing is most marked on the thumb nail. On all the nails it is localized nearly equally far distant from the nail root. Such kinds of nails are also less resistant to nail affections, such as trichophytia (fig. 1).

SURVEY OF LITERATURE

The first observations of transverse nail furrows were described by Reil (1792) who had seen them in convalescents after "malign fever." Beau (1846) gives a detailed description of the same phenomenon.

A physiologic white transverse nail furrow is often seen in newborns. Schick looks upon the transition from fetal to extrafetal nutrition as the reason for this phenomenon. It is due to the general conversion of the infantile assimilation during the first days of life, which is also revealed by the first physiologic loss of weight. Any disturbance influencing an infant's growth can check the extension of the nail line.

Dermatologists most frequently mention the transverse furrows in different diseases. They described them in connection with typhus, spotted fever, pneumonia, erysipelas, parotitis, and other affections. Jadassohn mentions the case of a physician whose fingernails showed transverse furrows after he had become a vegetarian. Heller reports transverse nail furrows in a patient after a heavy intestinal disease. From them, he was able to draw a conclusion as to the beginning

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Fig. 1 (Obal). Transverse furrowing of the nails and trichophytosis in nutritional amblyopia. Blurring of the vision occurred after eight months' internment on a starvation diet in a camp near Berlin. In the following period, the nails showed transverse furrows and became fragile and splintered.

and the duration of the affection. Beau, too, describes the nail furrows in connection with severe intestinal disturbances. He also saw similar nail variations in women after confinement.

In his manual, Sutton reports a case of pellagra in which deterioration of the general condition of health was accompanied by white transverse furrows on all the finger-nails.

In six to eight weeks after the beginning of scarlet fever, a distinctly marked furrow appears in consequence of an irregular nail growth during the period of the general exanthem. The same phenomenon is seen after a generalized drug exanthem of a salvarsan dermatitis.

Bielschowsky reports a case of alcohol polyneuritis of a man, aged 40 years, who showed such variations of nail growth as a result of a trophic disturbance.

Guenther (1842) was the first to observe

a stop of nail growth and the appearance of transverse furrows after fractures of the long extremity bones.

Montgomery describes a case of Reynaud's disease—white and cold fingers—in a man. After a longer attack of Reynaud's disease, Beau-lines appeared on all his nails. The lack of oxygen in the tissues during the spasm of the blood vessels is regarded as the cause of this disturbance of nail growth.

Numerous white transverse furrows of the nails are called leukonychia striata and are the same as "Beau-furrows"; they are frequent in arsenical poisonings (Aldrich, Reynold) and heavy poisonings with carbon monoxide.

According to Heller, there are many analogies to the human transverse nail furrows among the animals. Horses, for example, can show furrows on their hoof nails after certain diseases. From the depth of these furrows, as well as from the breadth of the separating segments, one can draw conclusions as to the duration and the severity of the disease. After calving, a cow may show a ring at the root of both her horns.

PRESENT OBSERVATIONS

During the last postwar years, I found similar transverse nail furrows among Berlin patients suffering from nutritional amblyopia. Among 50 patients with central scotomas, there were 12 fresh cases, nine of which showed this symptom. In the thorough examination to determine the etiology of the central scotomas, it was of importance to exclude affections of the central nervous system, such as cerebral tumors and multiple sclerosis. In new cases, these nail variations proved of diagnostic value.

The cause of these variations in nail growth seems to be a disturbance of the autonomic nervous system. Angioneurotic symptoms, intermittent claudication, and trophic disturbances of hair growth probably have the same origin.

It is remarkable that all these symptoms do not appear when the patient's nutritional



Fig. 2 (Ohal). Transverse furrows of the nails at the nail roots in nutritional amblyopia, two months after the first blurring of vision.

state is worst, but rather during the convalescence in a period of physical rest and a relatively better nutrition. At the same time, younger men especially showed disturbances due to an insufficiency of the hormonal glands, such as gynecomastia, paradoxical obesity, stop of beard growth, impotence, and so forth.

One gets the impression that the patient falls from one pathologic condition—the malnutrition—into another one—the dystrophia. The primary disturbance from lasting undernourishment probably has its origin in the primitive, phylogenetically old centers of the hypothalamic region. These centers guide the autonomic nervous system and, with it, the autonomically influenced system of endocrine glands. They are responsible for any dystrophic changes occurring in the human body. These are the dystrophic processes of the whole central nervous system, including the polyneuritic symptoms and the optic atrophy as well as the trophic disturbances of hair and nail growth.

The general neuritic symptoms are more or less subjective ones and thus cannot be shown graphically, though in nearly all our patients we found symptoms of a cerebral insufficiency, such as an emotional irritability, forgetfulness, disability to concentrate, and so forth. In the eye, however, the campimeter examination enables one to register the loss of function by making a drawing of the size of the scotomas. On the nails,

the same pathologic process of the autonomic nervous system registers itself as transverse nail furrows.

REPORT OF CASES

The following case reports of patients with central scotomas caused by malnutrition may serve to show the diagnostic value of nail alterations.

CASE 1

History. An agricultural worker, aged 47 years, had a stomach resection in February, 1948 because of a stomach ulcer. The following summer the patient showed a further loss of weight (about 20 Kg.) due to hard farm work and very poor food, which was greatly lacking in fats and proteins. In October, 1948, the patient suffered a rapidly increasing deterioration of vision in his right eye. Vision on his left eye had always been weak (strabismus).

When his stomach disease became manifest, the patient began to abstain from smoking and alcohol.

Eye examination. In January 1949, I found normal anterior parts of the eye; a 25-degree convergent strabismus of his left eye; no pathologic changes of the fundus.

Vision was: R.E., 5/50, no Nieden; L.E., 0.5/24, Nieden 9. The visual field of the right eye showed a relative scotoma of about 10 degrees of radius. Local adaptation for white and colors was shortened and there was increased dazzling. Green was not recognized; the visual fields for blue and red were slightly restricted. Dark adaptation was not remarkably diminished.

Neurologic examination. Psychic irritability and forgetfulness were increased. There was numbness of the fingers; a burning feeling on the tongue. No objective neurologic findings and normal reflexes were elicited.

Internal examination. There was no focal infection. Atrophy of all the muscles, achylia, and anacidity were present. X-ray studies revealed a

heavy loss of calcium in the bones. Blood studies showed normal red and white blood cells, and hypoproteinemia. Symptoms of a cardiac weakness with edema of the legs were present.

The nails showed marked transverse furrows on their roots (fig. 2).

Course. The patient was hospitalized in the IInd Medical Clinic of the Charité. There he was treated with an adequate diet combined with injections of vitamin B₁₂, riboflavin, and liver.

In April, 1949, an eye examination revealed no remarkable improvement of far vision. Near vision, however, had considerably improved (Nieden 3). The visual field had changed to a small central scotoma of four degrees of radius, the fixation area showing less depression.

Campimeter examination in April, 1949, showed small paracentral scotomas of the right eye. Now the patient could distinguish all colors even green, although the peripheral visual field for colors was still restricted.

The general malnutritional symptoms had disappeared but for swellings of the face, without any edema of the eyelids, and furrows of the nails (fig. 3). When patient left the hospital in June, 1949, the visual disturbances were improving.

In September, 1949, there were still paracentral scotomas in the right eye and good function (5/10, Nieden 2). There was temporal paleness of the right nervehead, but the nervehead of the left squinting eye had a normal color. In other patients, too, I observed that the squinting eye was not stricken with nutritional amblyopia.

CASE 2

History. A merchant, aged 38 years, was released, after two and one-half years' internment, in November, 1947. After a loss of about 20 Kg. of weight, he was in a state of cachexy and severe undernourishment. He suffered from furunculosis and edema in his legs.

After rest and better nutrition during the next two months at home, swellings appeared all over his body, which gave him a "fat" look. He suffered from burning in the toes and fingers, no appetite, physical and mental disability. At that time patient was mostly bedridden and suffered from a heavy perspiration at night. The skin of his hands, arms, and the upper part of his body was sore and flaky as in pellagra. He also showed such hormonal disturbances as stop of beard growth, a swelling of his right mamma (gynecomastia), and deficient libido.

At the same time, in December, 1947, heavy blurring of vision, accompanied by photophobia, occurred within a few days.

Eye examination. In May, 1948, when the patient came for treatment, the findings were: Edema of the face and both parotid glands without a swelling of the eyelids; transverse nail-furrows (fig. 4).

Vision was: R.E., 1/24, Nieden 9; L.E., 2/24, Nieden, 8.

There was moderate temporal pallor of both discs but no coarse macular variations. A relative central scotoma of more than 10 degrees for white and colors was found in the visual field. Campimeter examination revealed no absolute scotomas.



Fig. 3 (Obal). The nails of the same patient as shown in Figure 2, six months after the first blurring of vision. The transverse furrows have nearly reached the free nail edge.

A dark-adaptation test proved sufficient dark adaptation.

Further physical findings were generalized edema and subacid gastritis with a gastrogenic diarrhea. Neurologic examination showed a zone of hypersensitivity at the thigh and increased reflexes of the legs.

Therapy included oral administration of yeast and proteins and parenteral vitamin B₁₂. Vision improved rather slowly on riboflavin therapy. At first a small visual rest appeared in the central scotoma. Paracentral scotomas, however, remained even after two years' treatment and still impair the patient's working-ability.

CASE 3

History. A student, aged 27 years, in September, 1941, when lying wounded in a military hospital and being in poor general health, which had been greatly impaired by great physical hardships, showed a temporary blurring of vision. When reading, he perceived that single letters of the words were missing.

These disturbances disappeared with the improvement of his general condition. They returned, however, more intensively in 1943 after he was again wounded and had to have a high amputation of his left leg.

The symptoms were then white spots when reading, no night-blindness, but increased dazzling. When the patient recovered, the visual disturbances became less perceptible.

After the end of the war, there was again a deterioration of the patient's general condition of health, due to a dietary deficiency. In consequence, blurring of vision reappeared with greater intensity.

Eye examination. In June, 1948, vision was: R.E., 5/10 (partly), Niden 1 (partly) with a -1.25D. cyl. ax. 20°; L.E., 5/7, Niden 1 (partly) with a -0.75D. sph. \cap 0.75D. cyl. ax. 0°.

The lens and cornea were clear. Discs were nor-



Fig. 4 (Obal). Transverse nail furrows in nutritional amblyopia, five months after the beginning of the eye disease.

mal; the macula somewhat granulated and without the regular reflexes. Fields showed normal limits for white, but a constriction for colors. On the central visual field were found several small paracentral scotomas up to a distance of three degrees from the fixation point. Dark-adaptation was good.

General examination. No edema was apparent. There was marked underweight, with vasoneurotic, peripheral disturbances of the circulation and a stationary tuberculous process of the lungs and some infiltration in the amputation stump. The fingernails showed remarkable white transverse furrows, similar to those described as leukonychia striata in relapsing disturbances of the general health (fig. 5).

Neurologic findings. The patient complained of a decrease of his ability to do mental work and psychic irritability. There were no symptoms of a polyneuritis, although the reflexes were somewhat intensified. Later, the neurologic examination was repeated several times but there were never any symptoms of multiple sclerosis.

On the strength of the general examination, the diagnosis was nutritional amblyopia.



Fig. 5 (Obal). White transverse stripes of the nails (leukonychia striata). The patient has small paracentral scotomas and suffers from relapsing disturbances of the general health.

This patient has now been under continuous treatment with yeast and injections of liver extracts, as well as vitamin B₁ and riboflavin. The paracentral scotomas are unchanged; nevertheless, he has always been able to continue his study of architecture.

Disturbances of his general health are always followed by a temporary blurring of vision and a heavy dazzling. Colors, especially green, can be distinguished only with difficulty. Formerly his color vision had been excellent.

CASE 4

History. Dr. R. H., aged 43 years, returned from captivity at the beginning of 1949; he had been severely exhausted and undernourished. About three months later, he noticed a sudden deterioration of vision. He used no alcohol, and smoked two to three cigarettes a day.

Eye findings. Vision was: R.E., 5/50, Niden 11; L.E., 5/4, Niden 1. There was a relative central scotoma of his right eye which extended to about 10 degrees of the radius. No color vision was present. The left eye seemed entirely normal; there were no scotomas. The discs of both eyes were normal.

General examination revealed cardiac weakness, moderate edemas of the legs, slight polyneuritic symptoms of the arms and legs, normal blood count, hypoproteinemia, and no pathologic reflexes. Although X-ray studies and objective neurologic findings proved negative, the neurologist at first suspected a sella-tumor, as the patient showed, somewhat the features of acromegaly; however, the patient stressed that he always had had such features, and the history and especially the transverse nail furrows supported my assumption that his condition was nutritional amblyopia. Further onset of the disease confirmed this diagnosis.

I advised him to take injections of riboflavin and to try to have an adequate diet, rich in proteins, and to abstain entirely from alcohol and nicotine.

By June, 1949, vision of patient's right eye had improved. Now, however, the left eye began to experience the same dimness of vision that the right eye had had one month before. The patient complained of a painful dazzling, especially in bright sunshine or when looking at blue color.

Eye examination. Vision was: R.E., 5/10

(partly), Niden 2; L.E., 5/50, Niden 10. Campimeter tests showed: R.E., paracentral scotomas near the point of fixation; L.E., a relative central scotoma about 10 degrees of radius. Color vision: R.E., only green could not be recognized; L.E., no colors.

Fundus examination revealed normal color of the discs but the normal light reflexes of the macular region were missing.

In the course of the next months, the patient took abundant quantities of riboflavin.

When edema of the face appeared, extract of the thyroid gland was recommended, as was a glass of wine after luncheon and dinner. This treatment seemed to be the most effective one. A control examination in November, 1949, revealed only small paracentral scotomas with good central vision. His ability to carry out his profession as a general practitioner was no longer restricted. The right eye was almost normal but the left one had vision of 5/15 (partly).

In this case the nail variations gave the first hint to the correct diagnosis, that of nutritional amblyopia, which was confirmed by further ophthalmic and neurologic findings. Thus the patient, who had at first been alarmed by the assumption of an intracranial process, could be reassured.

SUMMARY

A transverse furrowing of the fingernails is described as a differential diagnostic mark in central scotomas due to retrobulbar neuritis. In new cases it enables one to make the important distinction between central scotomas caused by tumors of the brain and other diseases of the central nervous system, on the one hand, and scotomas due to nutritional amblyopia on the other hand. The same pathologic condition, which provokes the amblyopia after severe undernourishment, seems also to cause these changes of nail growth.

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THE RETRACTED EYE SOCKET*

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The retracted eye socket has been a problem to ophthalmologists and eye prosthesis makers since the middle of the past century when the operation of simple enucleation replaced the former brutal operation of abscission of the eye. The introduction of simple enucleation is generally attributed to Ferrall¹ and Bonnet² in 1841. However, the operation was well described by Cleobury³ in 1826. This was pointed out by Dimitry⁴ a few years ago.

During the following 30 years, there was dissatisfaction with simple enucleation because of the deep-set, immobile artificial eye, and the excessive collection of secretion behind the prosthesis. Noyes⁵ in 1872 and Froelich⁶ in 1881 proposed simple evisceration to produce a less retracted and more mobile stump.

The greatest surgical contribution to limit retraction of the socket following evisceration or enucleation was the introduction of the glass sphere in 1885 by Mules⁷ as an implant in the sclera, later used by Frost⁸ and Lang⁹ in 1887 as an implant in Tenon's capsule. In 1902, Fox¹⁰ proposed the use of hollow gold spheres as implants.

During the next 25 years, many ophthalmic surgeons were of the opinion that a glass or gold sphere was not well tolerated by the orbital tissues, and was too often extruded. Many vital materials (cartilage, fat, bone, animal eyes) and nonvital materials (silver, platinum, paraffin, vaseline, celluloid) were proposed. As recently as 1917, Wheeler¹¹ stated that fat, first proposed by Barraquer¹² in 1901, was a more satisfactory implant than metal, paraffin, sponge, or other materials. Later he used only glass or gold spheres.

Doherty¹³ in 1923 expressed the opinion

that beef cartilage would supersede gold, glass, or fat. However, in 1939¹⁴ he proposed the use of a vitallium sphere. His only objection to gold at that time was that there might be chemical decomposition in the tissues.

This has apparently not been true except possibly in one recent case reported by Forster and Dickey¹⁵ in which an allergic conjunctivitis was attributed to sensitivity to a gold ball implant. The rarity of this occurrence makes one suspect that there may have been a fistulous tract between Tenon's capsule and the conjunctival sac in this case.

Verhoeff, in 1918, was apparently the first to realize and demonstrate that firm suturing of Tenon's capsule, alone, over the implant resulted in practically no extrusions, even though a moderately large sphere was used. His first series of cases was reported by Howard.¹⁶ Previous to that time it had not been realized that the tension created by suturing the muscles over the implant was largely responsible for the wound breaking down and the sphere extruding.

Hollow spheres of gold, vitallium, or glass have survived through the past half century. In 1940 solid plastic spherical and conical implants were proposed by Berens¹⁷ but they have no real advantage over the hollow spheres. In recent years the plastic, methyl methacrylate (acrylic), has been popular in the various modifications of the Cutler¹⁸ implant.

Greenwood¹⁹ favored a large implant (20 or 22 mm.) in order to prevent any sinking of the upper lid. Guyton²⁰ has recently stated that 14 mm. is the optimum. I believe that most surgeons prefer an 18-mm. sphere in the average enucleation.

When one considers that the volume loss at the time of enucleation is about 6.5 to 7.0 cc., it seems logical to replace as much of this

* Candidate's thesis presented toward membership in the American Ophthalmological Society, accepted by the Committee on Theses.

as possible by means of the implant. A 14-mm. sphere has a volume of only 1.4 cc., whereas, an 18-mm. implant has twice that volume and leaves about 3.5 cc. of the volume loss to be replaced by the prosthesis. The average volume of the Snellen type of prosthesis is 2.5 to 3 cc. A 20-mm. sphere has a volume of 4.2 cc. and would theoretically seem to be the ideal size.

However, from the standpoint of many prosthesis makers, it is preferable to avoid too large an implant (Gougelman²¹). Also, the use of a 20- or 22-mm. sphere may cause too much tension on the sutures closing Tenon's capsule with consequent extrusion of the sphere.

During the past half century some improvements have been made in the eye prosthesis with the purpose of neutralizing the effects of a retracted socket. Prior to 1898, the glass prosthesis was of the shell type. At about the same time Snellen²² and Borsch²³ suggested to Müller that the artificial eyes be blown so that the posterior surface be less concave. This was the beginning of the Snellen "reform type" eye and was another step forward in combating the disfigurement caused by a sunken or retracted socket.

In 1907, Grossman²⁴ proposed that artificial eyes be made with a bulge at their upper anterior surface to abolish the appearance of enophthalmos that often occurs at the upper portion of the upper lid. However, 20 years later Gougelman expressed the opinion that a protrusion or flange of the upper part of the prosthesis was of little help and that too large a prosthesis caused an unsightly stare. He concluded that no great improvement had been made in the shape of the eye prosthesis since the Snellen reform eye.

The chief cause of retraction of the eye socket is the loss of volume resulting from the removal of the eyeball. Contributing factors may be a depressed fracture of the floor of the orbit, the wearing of a large prosthesis over a period of years, and some atrophy of the orbital tissues.

PROBLEMS OF RETRACTED EYE SOCKET

The problems often encountered in a case of retracted socket may be one or more of the following:

1. The prosthetic eye is enophthalmic and its upper portion tilts backward. Such a prosthesis usually has little motility.

2. There is a retraction of the skin and tissues below the supraorbital rim. This has been called retrotarsal atrophy by some writers (Spaeth,²⁵ Cutler²⁶), but certainly can be entirely explained on a mechanical basis by the retraction and settling or sinking of the orbital tissues resulting from loss of volume.

There is at times sufficient retraction of the levator to cause the upper lid to be in the open position when no prosthesis is in place. This retraction of the upper lid presents an insurmountable problem to the artificial eye maker because any attempt to make a large enough prosthesis causes the eye to stare.

3. Loss of the normal fold of the upper lid results from the retraction of the upper lid tissues. This retraction and loss of fold may be especially marked when there is an accompanying depression of the orbital floor from an old fracture.

4. Relaxation, depression, and ectropion of the lower eyelid gradually result from wearing too large a prosthesis over a period of years, the prosthesis having been made large in an attempt to correct the problems already listed.

5. A gradual loss of the lower cul-de-sac, or "flattening" of the floor of the socket, results so that a prosthesis can no longer be worn.

In attempting to solve the problems presented by a retracted socket one should bear in mind its mode of development, as presented in the preceding paragraphs. There can be no question that the primary cause is lack of sufficient volume of the orbital tissues. This can usually be prevented at the time of enucleation or evisceration by the

use of a sufficiently large implant.

I cannot agree with Guyton that a sphere implanted in Tenon's capsule should never be larger than 18 mm. and that 14 mm. is the optimum. Except in infants or in shrunken or badly lacerated globes an 18-mm. implant is the usual optimum; and at times a 20-mm. sphere may be used without undue tension on the closure of Tenon's capsule.

THE LATE IMPLANT

If there has been no implant at the time of enucleation, the first step in the correction of the retracted socket is a late implant. In 1897, Fox²⁷ first reported this procedure, but he simply buried a Mules sphere in the center of the mass of orbital tissue through a temporally placed conjunctival incision. This often resulted in extrusion or migration of the sphere to an undesirable position.

In 1900, Portman²⁸ reported an improvement on Fox's technique by dissecting the muscles sufficiently to close them over the glass ball. Two years later, when Fox first reported on the use of his gold sphere as a late implant, he stated that about one third of the late implants he had used were extruded until he used additional deep tension sutures. He also felt that the use of his conformer aided in the firm healing of the tissues.

Suker²⁹ attempted to solve the problem of retracted sockets by injecting paraffin into Tenon's capsule or into the scleral cup if an evisceration had previously been performed. It was later found that paraffin often changed position and was sometimes extruded (Spratt³⁰).

For a number of years fat was favored as an implant material (Barraquer,³² Lauber,³¹ Spratt,³⁰ Weidler,³³ Wheeler³⁴). It is now generally agreed that fat implants undergo a fair amount of absorption, although there have been cases in which the fat actually increased in volume (Gougelman).

Dermal grafts as a late implant have also been used (Witter³⁵) but it is known that

they undergo absorption and may form cysts (Wheeler,³⁴ Peer³⁴).

In 1938, Wheeler³⁵ reported on the use of a grooved hollow glass sphere as a late implant in the muscle cone behind the organized mat of Tenon's capsule. Previous to that he had favored the use of fat as a late implant. He had also tried grooved cork spheres in the muscle cone but found that they gradually disintegrated.

The purpose of the grooves is to accommodate the four rectus muscles and thus hold the implant in place. In my opinion, the usefulness of this implant has not been fully appreciated. It will provide a definitely larger volume than can be contained in a late re-opening of Tenon's capsule. The latter will usually accommodate a sphere no larger than 14 mm., a volume of 1.4 cc. compared with the 2.5-cc. volume of an 18-mm. Wheeler grooved sphere.

It has been stated that this type of sphere will often migrate out of the muscle cone (Cutler,³⁶ De Voe³⁷). In my experience these implants have little tendency to migrate if the grooves are deep enough (fig. 5). The reader is referred to the illustration of the implant in Wheeler's original article. Unfortunately many of these spheres have been placed on the market with very shallow grooves (see illustrations in the catalogue of Meyrowitz, June, 1940, and Storz, 1950). The makers seem to have lost sight of the original design and purpose of the implant.

My associates and I have used a grooved sphere of glass or acrylic in about 50 cases of retracted socket following a simple enucleation with no implant. In two of these cases, the sphere was extruded soon after operation because of undue tension on the tissues sutured over too large an implant. The remaining cases were definitely improved, in that a smaller prosthesis could be worn with much less sunken appearance and with improvement in motility. Fifty percent of these cases were considered very satisfactory; in the other 50 percent there was room for

further improvement in appearance.

Two cases illustrate the use of the procedure:

CASE 1

A 20-year-old man had a simple enucleation per-



Fig. 1 (Sherman). Case 1. Preoperative appearance.



Fig. 2 (Sherman). Case 1. Postoperative appearance.



Fig. 3 (Sherman). Case 2. Preoperative appearance.



Fig. 4 (Sherman). Case 2. Postoperative appearance.

formed at an overseas hospital four weeks after a lacerated wound of the left eye. He was admitted to our hospital three months later because a satisfactory eye prosthesis could not be fitted (fig. 1).

There was no evidence of injury to his eyelids. He was wearing a moderate-sized prosthesis on the left which had a deep-set, sunken, appearance with an accompanying deep sulcus below the brow and loss of the normal upper fold. The socket was large, had adequate fornices, and the upper portion was quite retracted. No implant was palpable.

At operation, an 18-mm. grooved, glass sphere was placed in the muscle cone behind Tenon's capsule, following Wheeler's technique. Healing was uneventful. Figure 2 shows the appearance two months after surgery and the final fitting of a prosthesis.

CASE 2

The appearance of this 26-year-old patient at the time of admission to our hospital four months after initial repair of the left eyelids and eyebrow is shown in Figure 3. He had had a simple enucleation following lacerated wounds of the eyelids, eyebrow, and eye.

A linear scar extended down from the brow between the middle and lateral thirds of the upper eyelid to the margin. The lateral third of the lid margins were adherent. There was cicatricial contraction of the lateral portion of the socket.

Further repair of the eyelids was first carried out by excision of the vertical scar with halving repair, and later eyelash grafts to the lateral thirds of the lids. Following this, the lateral third of the lids was cut apart and the lateral socket enlarged by excision of scar tissue and a mucous membrane graft from the lower lip. A small lateral canthoplasty gave a better lateral canthal angle.

Because the socket was retracted, an 18-mm., grooved, glass sphere was implanted in the muscle cone behind Tenon's capsule. At the same time the powder burn below the nasal portion of the lower eyelid was excised. The final appearance is shown three months later (fig. 4).

Comment. Case 1 illustrates the marked improvement resulting from a late implant in an uncomplicated case of simple enucleation. The second case was complicated by deformity of the eyelids and cicatricial contracture of the lateral socket. The appearance of the upper eyelid area in this case could have been improved by elevation of the orbital contents by means of an implant to the floor of the orbit, which is to be discussed in the following section.

IMPLANTS TO THE UPPER EYELID

The retraction of the tissues of the upper portion of the upper eyelid with loss of nor-

mal skin fold may be present in cases that have had a sufficiently large implant at the time of enucleation or evisceration. However, it is much more likely to be present in cases that have had a small implant at the time of enucleation or have had a simple evisceration. This is especially true if an old depressed fracture of the floor of the orbit is also present.

As already stated, the attempt to correct this upper eyelid deformity by building up the upper portion of the prosthesis is seldom satisfactory. This too often results in a widened fissure with a staring appearance, and later a depression of the lower eyelid.

One method of correcting the sunken appearance below the brow has been to implant some material to fill out this area. A number of surgeons have used fascia for this purpose (Spaeth,²⁵ Cutler²⁶); others have used a dermal graft (Smith,²⁸ De Voe²⁷).

Fascia is the better of these two vital tissues because it undergoes no absorption (Davis,²⁹ Wheeler⁴⁰). Peer³⁴ has demonstrated histologically that a buried dermal graft undergoes some absorption and fibrous-tissue replacement, and may form cysts. De Voe found the dermal graft unsatisfactory because of absorption. With either fascia or dermal graft the final contour of the eyelid seldom matches the opposite normal side.

Sugar⁴¹ devised an acrylic implant shaped somewhat like a thin pickle. Even with a variety of sizes one cannot be certain of perfectly natural contour and also there can be some late displacement of this implant.

Although an implant to the upper lid does help to eliminate the sunken appearance, it is not entirely satisfactory because of the uncertainty of the final contour and because it also may cause some ptosis.

IMPLANTS TO THE FLOOR OF THE ORBIT

Since the sinking above the upper lid is secondary to the sinking and retraction of the orbital contents in general, the logical approach to correct this deformity is to elevate



Fig. 5 (Sherman). Three sizes of wedge acrylic implants. Below is shown an 18-mm. grooved sphere implant of acrylic.

and bring forward the posterior portion of the socket. I am in entire agreement with De Voe that this is a better approach to the problem than attempting to fill out the upper lid with a direct implant.

This is not a new method of approach. Murphy⁴² in 1915 was apparently the first to use an osteoperiosteal graft from the tibia to the lateral wall and floor of the orbit to elevate an enophthalmic eye in a case of old orbital fracture. He reported that the eye was fully elevated.

Davis,⁴³ Gilles,⁴⁴ Spaeth,⁴⁵ and others have used cartilage implants to the floor of the orbit in cases of anophthalmos as well as cases of enophthalmos. Wheeler⁴⁰ used fascia.

During and following the World War II, a new interest in this problem developed because of the large number of cases of anophthalmos with or without fracture of the floor of the orbit.

Converse⁴⁶ used bone from the ilium to elevate the orbital contents, and also stated that, "the present tendency toward the use of acrylics as buried material might well find application in the reconstruction of the floor of the orbit, either as a temporary support, before the introduction of bone, or as a permanent means of reconstruction."

In a discussion of Converse's paper, Paton suggested that vitallium wedges might be used.

Struble⁴⁷ used tantalum wool or mesh to fill in bony defects within the orbit before inserting the Ruedemann implant eye.

Souders⁴⁸ used flat, rhomboid-shaped plates of acrylic to cover defects in the floor of the orbit in old fracture cases with depression of the eyeball. These were placed on the periosteum rather than under it, and were held in position by sutures through small holes in the anterior portion of the plate.

De Voe⁴⁹ first used cartilage and then glass wool, packed under the periosteum in sufficient quantity to elevate the orbital contents and eliminate the retraction of the upper lid tissues.

While I was stationed at O'Reilly General Hospital from 1944 to 1946, my associates and I were often faced with the problems of the retracted socket. Most of these problem cases had had a simple enucleation with a small implant into Tenon's capsule, or a simple evisceration.

It was mainly because of the retraction of the levator and upper lid tissues that the fitting of a satisfactory prosthesis was impossible. As already stated, a number of the cases of simple enucleation were well corrected by means of a late implant.

The next logical approach to the problem seemed to be the use of some method of elevating and bringing forward the retracted orbital contents. Preserved cartilage was not available for this and the obtaining of fresh cartilage meant an additional operation.

In early 1945, we began to use wedge-shaped pieces of acrylic as an implant to the floor of the orbit under the periorbital. These were made in three sizes, having a volume of 2.0, 2.5, and 3.0 cc., respectively (fig. 5). At times more than one piece was used. These implants can be made by any dental prosthetic laboratory. I have been unable to find any reference in the literature that acrylic undergoes any change or causes any appreciable tissue reaction when used as a buried implant.

This type of implant was used in 32 cases

of anophthalmos. Of this number, 19 had had a simple enucleation, seven an enucleation with small or medium implant in Tenon's capsule, and six a simple evisceration. In eight of the cases of simple enucleation, a grooved sphere late implant in the muscle cone behind Tenon's capsule was used prior to the implant to the floor of the orbit.

In 14 of the total of 32 cases, the final cosmetic result was considered excellent, in 10 good, and in eight only fair. Most of the latter had rather severe injuries, necessitating eyelid and orbital reconstruction. In one of these cases a fascia lata implant to the upper portion of the upper eyelid was also used.

Of the total 32 cases, 21 had had an accompanying fracture of the floor or roof of the orbit at the time of the original injury. In only one case did the implant to the floor become displaced forward; this was the result of a hematoma which opened the periosteal suturing. Two later attempts to place this implant in better position were unsuccessful and the implant was finally removed.

The following cases illustrate the use of the wedge acrylic implant to the floor of the orbit.

CASE 3

This 25-year-old soldier had a simple enucleation of the left eye following a penetrating wound from a bomb fragment. Attempts to fit an artificial eye three months later were not satisfactory. He was sent to us about five months after enucleation. At that time he was wearing a large prosthesis and had disfiguring retraction of the upper eyelid below the brow (fig. 6).

The socket was large and quite retracted, especially above. There was a small notch of the lower lid margin with a narrow band of scar tissue extending back along the floor of the socket.

After a halving repair of the lid notch and excision of the scar tissue band, a large wedge acrylic implant was placed on the floor of the orbit under the periorbital. This procedure is done through the usual external approach by means of a horizontal incision over the lower orbital margin, incising periosteum at the margin and thoroughly elevating the periorbital almost back to the apex of the orbit.

After inserting the implant with thick end posterior, the periosteum at the margin is closed with

fine gut mattress sutures. Several subcutaneous gut sutures are also used to prevent a depressed scar, and the skin is closed with interrupted silk.

Figure 7 shows the result two months later, after a new, smaller prosthesis was fitted.

CASE 4

This 25-year-old soldier incurred lacerated wounds of the right eye and eyelids with fracture of the maxilla when a bullet struck the front edge of his helmet. His eye was enucleated the same day. Several plastic operations were later performed on his eyelids and eye socket at an overseas general hospital. His appearance on admission to our hospital 10 months later is shown in Figure 8.

His socket was adequate but retracted above. A moderate-sized spherical implant could be palpated. There was a small epidermal graft present in the lower temporal portion of the socket.

Following an eyelash graft to the lower eyelid he

was fitted with a prosthesis (fig. 9). Because of the retraction of the area below the brow, the socket was elevated by using a large and a small wedge acrylic implant under the periorbital of the floor.

Figures 10 and 11 show the change in position of the spherical implant in Tenon's capsule resulting from the implant to the depressed floor of the orbit. The final result is shown in Figure 12.

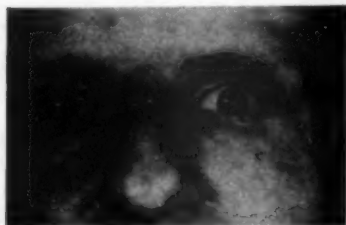


Fig. 6 (Sherman). Case 3.
Preoperative appearance.



Fig. 7 (Sherman). Case 3.
Postoperative appearance.



Fig. 8 (Sherman). Case 4.
Preoperative appearance.



Fig. 9 (Sherman). Case 4. Before
implant to floor of orbit.

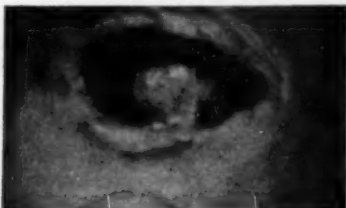


Fig. 10 (Sherman). Case 4. Socket be-
fore implant to floor of orbit.

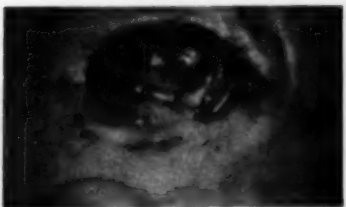


Fig. 11. (Sherman). Case 4. Socket
after implant to floor of orbit.



Fig. 12 (Sherman). Case 4. Final
appearance.



Fig. 13 (Sherman). Case 5.
Preoperative appearance.



Fig. 14 (Sherman). Case 5. Final appearance after implant to floor of orbit.



Fig. 15 (Sherman). Case 6.
Preoperative appearance.



Fig. 16 (Sherman). Case 6.
Postoperative appearance.

CASE 5

This 28-year-old lieutenant's right eye was enucleated following a bullet wound. Later at an overseas hospital a split-skin graft was done to enlarge the upper temporal portion of the socket. After some plastic repair to the lateral canthal area, he was fitted with a prosthesis and returned to duty.

He was admitted to our hospital one year after original injury because of excessive mucous discharge from the socket. He was wearing a large

prosthesis with some relaxation of the lower eyelid and some ptosis of the nasal two thirds of the upper eyelid (fig. 13). There was some retraction of the tissues below the brow. A large Thiersch graft was present in the upper temporal portion of the socket.

Following replacement of the Thiersch graft with a mucous-membrane graft, the orbital contents were elevated by means of a wedge acrylic implant to the floor of the orbit. Later a Kuhnt-Szymanowski operation was performed to correct the relaxed lower eyelid and he was fitted with a new prosthesis (fig. 14).

Comment. Case 3 illustrates the use of an implant to elevate the orbital contents in an uncomplicated case of simple enucleation. The result was quite good but could be still better if an implant in the muscle cone were also used.

Case 4 already had an implant in Tenon's capsule and also a fracture of the floor of the orbit. Considerable improvement resulted from an implant to the floor of the orbit.

Case 5 also should have had a late implant in the muscle cone and a resection of the nasal two thirds of the levator and tarsus. The case illustrates the fallacy of combining skin and conjunctiva in a socket and also the depression and relaxation of the lower eyelid from a large, heavy prosthesis.

In the following cases a late implant in the muscle cone behind Tenon's capsule and an implant to the floor of the orbit were used.

CASE 6

This 25-year-old soldier was admitted to our hospital six months after enucleation of the left eye because of a shell fragment wound. He was wearing a large prosthesis in a markedly retracted socket. In spite of the size of the prosthesis it had a sunken appearance (fig. 15).

Two months after an 18-mm. grooved glass-sphere implant in the muscle cone, a medium-sized wedge acrylic implant was placed under the periorbital of the floor of the orbit. Two months later he was fitted with a new prosthesis (fig. 16).

CASE 7

This 30-year-old soldier had multiple wounds from shell fragments. One of these passed through the left eye and orbit, lodging in the right parietal area. A simple enucleation and craniotomy were performed the next day. Seven months later, he was evacuated from overseas and admitted to our hospital.

He was wearing a large prosthesis in a very retracted left eye socket (fig. 17).

The lower nasal fornix was practically obliterated by scar tissue.

A large grooved glass sphere was implanted in the muscle cone behind Tenon's capsule and one month later, the lower nasal cul-de-sac was enlarged by means of a mucous-membrane graft.

Three months later the orbital contents were elevated by means of a large wedge acrylic implant to the floor of the orbit. Figure 18 shows his appearance three months later, wearing a considerably smaller prosthesis.

Comment. In Cases 6 and 7, the volume of the orbital contents was increased from four to five cc. by mean of a late implant in the muscle cone and an implant to the floor of the orbit. Both were greatly improved by these procedures in that the retracted or sunken appearance of the artificial eye was eliminated and the appearance of the upper eyelid greatly improved.

RELAXED LOWER EYELID AND LOSS OF LOWER CUL-DE-SAC

As already stated, an occasional complication accompanying a retracted socket is the relaxed, depressed lower eyelid, which may be everted. This is usually due to the wearing of a large prosthesis over a long period of time and is usually accompanied by a loss of the lower cul-de-sac. The latter may also result from not wearing any prosthesis over a period of years. At times the loss of the lower cul-de-sac is due to cicatricial contraction following the original injury. Usually the deficient lower cul-de-sac should be corrected before any surgery to correct the relaxed lower eyelid.

Henderson⁵⁰ was one of the first to describe the use of mattress sutures to draw the conjunctiva down to form a new lower fornix, the sutures being brought out through the skin below the eyelid. This was greatly improved upon in 1927 by Greeves,⁵¹ who dissected a pocket down to the lower orbital rim through a horizontal conjunctival incision one cm. below the lower lid margin. The three mattress sutures used to close the



Fig. 17 (Sherman). Case 7.
Preoperative appearance.



Fig. 18 (Sherman). Case 7.
Postoperative appearance.

incision were passed through the periosteum of the rim and tied on the skin surface over a strip of rubber.

This procedure was also later reported by Berens,⁵² in 1943, and De Voe,⁵⁷ in 1945. Berens stated that he first used it in 1916 but later preferred to undermine the conjunctiva through a vertical conjunctival incision placed temporally. Through the same incision he dissected down to the orbital rim. The mattress sutures are then placed through intact conjunctiva.

No one seems to have pointed out the advantage of combining a mattress suture operation of this type with a late implantation in Tenon's capsule or in the muscle cone. I have found this to be very useful.

The posterior portion of the socket is brought forward by the implant with resulting relaxation of the conjunctiva to be used for the new lower fornix. Through the usual horizontal incision of the conjunctiva of the posterior socket, the conjunctiva below can be thoroughly undermined as far as the lower margin of the tarsus, and also the pocket dissected down to the lower orbital margin.

After closing Tenon's capsule over the late implant, the three mattress sutures are passed through a strip of rubber, then

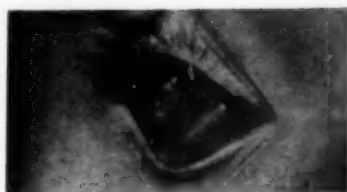


Fig. 19 (Sherman). Case 8. Postoperative appearance of the socket.



Fig. 20 (Sherman). Case 8. Postoperative appearance.

through the conjunctiva about six to seven mm. below the tarsus, through the periosteum at the orbital margin, and tied over a strip of rubber on the skin surface. The horizontal conjunctival incision is closed with interrupted or continuous silk suture.

Because of the extensive mobilization of the conjunctiva, there is little tension on the new lower fornix. The tied ends of the mattress sutures and the strip of rubber on the skin surface may be cut free at the time of the first dressing in six days. The remaining portion of the sutures and the strip of rubber in the lower fornix need not be removed until the second dressing several days later. The following case illustrates the use of this combined operation.

CASE 8

Miss M. M., aged 16 years, gave a history of having been struck in the right eye by a stone at the age of two years. The eye was removed a few days later. She had always worn as large an artificial eye as possible to lessen the sunken appearance. During the past two years there had been increasing difficulty keeping the eye in. It tended to fall out if she leaned over or blinked hard.

Examination showed a retracted socket with no implant palpable and practically no lower cul-de-sac. There was slight ectropion below. The combined operation of late implant in the muscle cone and repair of the lower cul-de-sac, as already described, was performed. An 18-mm. grooved sphere was used.

Figure 19 shows the socket seven months later. The lower cul-de-sac is of good depth and the fundus of the socket has been brought forward. Her appearance when wearing a prosthesis is shown in Figure 20. There is no sunken appearance of the prosthesis and no difficulty in keeping it in place.

When insufficient conjunctiva is present to form a lower cul-de-sac, because of cicatricial contracture, the cul-de-sac should be sufficiently enlarged by means of a mucous membrane graft. It is generally agreed that this is to be preferred to the use of a Thiersch or epidermal graft. A few writers still prefer the Thiersch graft but most prefer mucous membrane (Whalman,⁵³ De Voe,⁵⁷ Stallard,⁶⁴ Fox,⁵⁵ Mackenzie,⁵⁶ Greear⁵⁷).

Mucous membrane from the inner surface of the lower lip is usually used, although other sources are the prepuce, or labia minora (Clay and Baird⁵⁸), vagina (Majewski,⁵⁹ Karelus,⁶⁰ MacKenzie⁵⁶), rectal or nasal mucosa (MacKenzie).

As stressed by numerous writers (Wheeler,⁶¹ Spaeth,⁶² Smith,⁵⁸ De Voe,⁵⁷ Greear⁵⁷), dissection of the new lower fornix should be complete down to the floor of the orbit, and the new fornix held in contact with the periosteum by means of a form of dental molding compound or mattress sutures through rubber tubing (Greear).

Although Stellwag von Carion,⁶³ in 1873, first used mucous membrane from the mouth for free grafts to the eyelid, and Van Milligen,⁶⁴ in 1880, reported the use of narrow strip mucous membrane grafts from the lower lip in cases of trichiasis, I believe that Portman,⁵⁶ in 1900, first reported the use of a mucous membrane graft to restore the lower fornix in a case of anophthalmos. Previous to that, full-thickness skin grafts or Thiersch grafts had been used to restore the obliterated cul-de-sac (Hotz,⁶⁵ Morton,⁶⁶ May⁶⁷).

Portman's case report is of further interest in that she stated that the patient was still wearing the artificial eye one year later and the only problem was one of cleanliness

due to the epithelium from a previously placed skin graft in the upper fornix. The undesirability of combining a skin graft with conjunctiva in a socket has been stressed many times since (Wheeler,⁶⁸ Story,⁷⁰ Clay and Baird,⁸⁸ Sherman,⁶⁹ De Voe,⁸⁷ Fox,⁸⁵ Greear⁸⁷).

Operations such as that proposed by Maxwell,⁷¹ in 1903, and also used by Posey⁷² 15 years later, utilizing a flap of skin from the lower eyelid to form a cul-de-sac, have no place in surgery of the eye socket because of the resulting mutilation of the eyelid.

The relaxation and ectropion of the lower eyelid is often automatically corrected by the procedures already mentioned to correct the retracted socket itself and to form a new lower cul-de-sac. The change to a less bulky prosthesis in an adequate lower fornix eliminates the downward and forward thrust on the lower eyelid. At times it may be necessary to use an additional procedure to tighten the lower eyelid. Most writers are in agreement that a procedure of the Kuhnt-Szymanowski type is the most satisfactory for this purpose (Case 5).

The development of the so-called integrated or semiburied implants of the Cutler type during recent years has been well reviewed by Durham⁷³ and Guyton⁷⁴. It is Cutler's⁷⁵ opinion that, with the 18-mm. implant, none of the problems of a retracted socket arise. The striking advantage of these implants is, of course, the lifelike movement of the prosthesis. If some retraction or sinking of the socket does occur so that a depression below the brow develops, this could be well corrected by an implant to the floor of the orbit of the wedge acrylic type. It is gen-

erally agreed that the integrated implant has yet to stand the test of time.

SUMMARY

The methods of preventing or correcting the retracted eye socket during the past 100 years have been reviewed. It is concluded that a sufficiently large implant at the time of enucleation or evisceration is the chief means of preventing a retracted socket.

The first step in correcting a retracted socket is the use of the late implant, if one is not already present. A Wheeler grooved glass sphere implanted in the muscle cone behind Tenon's capsule is the method of choice, since it will add a larger volume than can be placed in a reopened Tenon's capsule.

If an implant is already present, additional correction can be obtained by an implant on the floor of the orbit. Preserved cartilage, bone, wedge-shaped acrylic, or glass wool will serve well for this. I prefer acrylic because no one has demonstrated that it undergoes change or causes appreciable tissue reaction when buried. It is easily obtainable and has no porous spaces in which blood and serum can collect.

Implants to the upper eyelid should be avoided.

Loss of the lower cul-de-sac can often be corrected by moving the conjunctiva downward into a pocket dissected down to the orbital rim. This can be combined with the operation for late implant, thus giving greater relaxation of the conjunctiva for the new fornix. If insufficient conjunctiva is present, mucous membrane from the lower lip is much preferred to the Thiersch graft.

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OPHTHALMIC MINIATURE

The view of things by means of the eyes is full of deception, as also is that through the ears and other senses. . . . but that it is the brain which produces the perceptions of hearing, seeing, and smelling, and that from these come memory and opinion.

Plato's *Phaedo*.

NOTES, CASES, INSTRUMENTS

OCULAR SPOROTRICHOSIS*

ADDITIONAL REFERENCES TO THE LITERATURE
AND REPORT OF A CASE

HARRY MCGRATH, M.D. AND

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Sporotrichosis is a chronic infection caused by the *Sporotrichum schenckii*. It is characterized by the development in the lymphatics, skin, or subcutaneous tissues of nodules which may soften and break down to form indolent ulcers.

The fungus exists saprophytically in nature upon vegetation, with a consequent high incidence of infection in laborers, farmers, and horticulturists. Pathogenic sporotricha have also been isolated from the hair of horses and other domestic animals and from their excreta.

Since infection from this fungus usually results from occupational trauma, exposed parts of the body such as the fingers, hands, and face are logical sites of origin for the initial lesion of this disease.

The most common clinical type of infection seen in this country is the lymphangitic form, composed of a nodule or sporotrichotic chancre at the site of inoculation, with a subsequent ascending lymphangitis and the formation of multiple subcutaneous nodules along the course of these lymph vessels. These nodules may or may not break down and ulcerate. The regional lymph nodes are infrequently involved.

A second type of this disease, the disseminated form, has been seen more frequently in France than in this country. Visceral, skeletal, and mucosal involvement may occur, but with relative rarity, as a primary disease.

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Lewis and Hopper¹ state that a few more than 200 cases have been recorded in this country. The majority have appeared in the Mississippi Valley.

Involvement of the eye is, as one would expect, of uncommon occurrence. In presenting the 10th case in American literature, Gordon² noted, in his excellent and thorough review, that ocular sporotrichosis had been reported in 48 instances in the world literature, including his own case.

His complete analysis shows that, of the 48 cases, 25 occurred in France, 10 in the United States, seven in South America, two in South Africa, and one each in Italy, Germany, Spain, and Egypt. In 34 of these, the disease was primary in the eye; in the remainder it was secondary to involvement elsewhere in the body.

Gordon's paper lists the anatomic distribution as follows. Lids, 17; conjunctiva, 10; lacrimal sac, two; conjunctiva and lacrimal apparatus, one; brow, one; intraocular, five; orbit and lids, five; cornea, three; limbus, one; uveal tract, one; lacrimal canal, one.

Besides the cases summarized by Gordon we wish to cite the following additional references. Hedge³ (1943) discussed an infection of the lower eyelid caused by a scratch from a barberry bush. This yielded *Sporotrichum schenckii* on culture.

Bargy⁴ in 1946 reported from France a patient with conjunctival sporotrichosis. Cultures were negative for the *Sporotrichum* but the patient responded rapidly to iodides and the author considered this of diagnostic significance.

Also in 1946, Graham⁵ referred to a case in which a mother apparently acquired an infection on the lower lid from a daughter who had sporotrichosis. The culture was positive. Graham's cases were from Pat-chogue, New York, a locality about 20 miles from our patient's residence. The child had

been playing in the same type of salt-meadow hay which we suspect to have been the source of infection in our case.

Again in 1946, Fisher⁶ presented a nine-year-old boy who developed a nodule which later became necrotic and formed an ulcer on the right eyelid. Other nodules appeared along the regional lymphatics of that side of the face. Culture of pus from a lesion grew the *Sporotrichum schenckii*. Contact with lettuce was suspected to be the source of infection.

Pessano and Negroni⁷ cited, in 1947, a case of sporotrichotic chancre of the lower eyelid with lymphangitic nodules along the face. Cultures were positive. No contact with vegetation could be determined.

Also in 1947, Smith and Garrett⁸ reported an infection of sporotrichosis on the cheek of a woman which extended onto the lower eyelid. Sources of the infection could not be determined but the cultures were typical.

The infrequent occurrence of this disease in the skin and the ocular tissues and the importance of its early recognition seem to justify the report of the following case. It appears to be the 15th instance of ocular involvement reported in the United States.

REPORT OF A CASE

History. E. K., a healthy looking boy, aged 11 years, living near Babylon, Long Island, was first seen by one of us (H. McG.) on December 12, 1949. He had complained of a swelling of the lower lid of the right eye for about a week. There was no history of any recent abrasion of the skin.

Examination showed a marked injection of the conjunctiva with slight chemosis. In the lower lid there was a subconjunctival nodule which had the appearance of a chalazion. He was given an ointment of sulfacetimide for local use.

When next seen on December 17, 1949, the chemosis of the conjunctiva was more extensive. On the surface of the conjunctival nodule observed previously there was an area of granulation. The preauricular gland on the involved side was enlarged and tender. Between this lymph node and the external canthus there were several subcutaneous nodules which were tender to palpation. Beneath the skin of the upper lid there was a similar nodule. No *leptothrix* was isolated from a conjunctival smear.

From his family physician the patient received duracillin in daily doses for a total of 2,700,000

units. Bacitracin ointment was used locally. He was next seen on December 22, 1949. His family physician had been unable to find any blood dyscrasia and there were no signs of any systemic disease. Wassermann and tuberculin tests were negative.

There was no evidence of any glandular involvement apart from the local condition. The eye was now almost closed and the lids could be separated with difficulty to disclose considerable conjunctival chemosis. The nodule in the lower lid revealed slight fluctuation.

In a triangular area of the cheek, which conformed to the facial surface of the malar bone, there were several nodules, some of which showed fluctuation. The preauricular and upper cervical glands were slightly enlarged and tender.

The cornea was intact and the anterior chamber clear.

The condition did not seem typical of Parinaud's conjunctivitis and the possibility of ocular glandular tularemia was considered.

Dermatologic consultation. At this point assistance from a dermatologist was considered desirable and one of us (J. I. S.) was called to see the boy in consultation. A diagnosis of sporotrichosis was suggested, besides tularemia, and therapy with aureomycin, 250 mg. for four days, and saturated solution of potassium iodide, commencing with five minims, three times daily, was advised.

There appeared to be insufficient fluctuation in any of the involved areas to obtain pus for culture. This procedure was accordingly delayed until December 31, 1949, when the upper lid was incised and a thick creamy pus was evacuated and cultured on Sabouraud's glucose agar medium, and another specimen of pus was sent to a bacteriologic laboratory.

Dermatologic examination revealed on the inner aspect of the lower lid at the ciliary border two adjacent hemp-seed sized papules. The entire upper lid was swollen, red, and fluctuant. Along the border of the lower lid were a few small red papules.

On the cheek over the zygoma four distinct rubbery, pea to cherry-sized nodules were present. They were flesh colored or slightly erythematous. At this time no regional lymphadenopathy could be detected.

Bacteriologic report. On January 3, 1950, the bacteriologic laboratory reported a pure culture of hemolytic *Staphylococcus albus*. Examination of the stained smear showed pus cells but no organisms. No acid-fast bacilli were seen on direct smear. Examination with Giemsa's stain showed on evidence of rickettsial infection.

On the Sabouraud's glucose agar a definite growth, one cm. in size, was noted (by J. I. S.) eight days after media inoculation. The central half of the gross culture was brown and wrinkled, while the periphery was cream colored and filamentous. Culture mount revealed fine mycelia with the ovoid or pyriform conidia borne on lateral branches. Rosette formation of microconidia was also seen. The

diagnosis of sporotrichosis was therefore established.*

Therapy with potassium iodide was increased by five drops daily until a total of 30 drops was being taken three times daily. The patient previously had discontinued aureomycin without instructions from the attending physicians.

Further questioning revealed the fact that, two to four weeks prior to the onset of any symptoms, he had played in salt-meadow hay used to mulch bulbs on a tulip farm behind his house. His mother



Fig. 1 (McGrath and Singer). Appearance of patient before treatment.

distinctly remembered brushing the hay out of his hair and off his face.

He tolerated the increased dose of potassium iodide very well. After an initial partial confluence of the nodules on the cheek, a gradual decrease in their size occurred.

On March 1, 1950, the conjunctiva appeared normal, except for persistence of a small granulation on the palpebral surface of the lower lid. The iodides were reduced gradually to 15 drops three times a day.

On April 1, 1950, there were a few insignificant indurations in the skin over the malar bone.

The eye appeared normal with the exception of a thickened fold of skin in the upper lid. The conjunctival granulation had disappeared. Visual acuity was normal in each eye. Therapy was now reduced to five drops of the potassium iodide once daily and discontinued a few weeks later.

* Dr. E. Muskathlit of New York City also examined this culture and confirmed the mycologic diagnosis.

DISCUSSION

There are several points in this case which merit emphasis. In the first place, the child seems to have acquired the infection from salt-meadow hay in which he had been playing. Graham, in 1946, reported the first instance of infection from this type of vegetation.

In addition to the case herein reported, one of us (J. I. S.) had the opportunity to observe three other cases of sporotrichosis on the arms where there was a definite history of trauma and contact with salt-meadow hay. The fungus seems to have a preference for this type of vegetation. The hay is used in this locality to cover planted tulip bulbs during the winter months. During the summer, it is stored in stacks and makes an enticing but potentially dangerous playground for children.

We would like also to point out that the large amount of penicillin administered had no effect on the fungus infection.

As far as the regional lymphadenopathy is concerned, we believe that this was produced by the secondary infection of the staphylococcus which was obtained on bacteriologic culture. This adenopathy subsided in a short time, apparently as a result of the penicillin



Fig. 2 (McGrath and Singer). Appearance of patient after treatment.

therapy. The mixed infection shows how easily one may miss the correct diagnosis by omitting fungus cultures.

The classic lymphangitic form of sporotrichosis is described as producing an ascending lymphangitis, since the inoculation occurs in the finger and the lymphatics draining this region anatomically ascend.

On the head and neck, however, the lymph vessels naturally drain by descending and, therefore, we would like to introduce into the terminology of the disease this form of sporotrichosis with a descending lymphangitis. Use of this terminology may result in more frequent recognition of the disease.

SUMMARY

A case of sporotrichosis with the primary inoculation on the palpebral conjunctiva, and with a descending lymphangitis, is described. Salt-meadow hay is believed to have harbored the fungus. The patient responded to oral therapy with potassium iodide. We believe this to be the 15th case of ocular sporotrichosis to be reported in the United States. Six additional instances of ocular sporotrichosis are summarized.

12 Shore Lane.
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LID SUTURES IN CATARACT SURGERY

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The exposure of the eye in cataract surgery presents a problem to which a generally accepted solution has not yet been found. Lid blades or clamps attached to a headband have their disadvantages, while the speculum is not safe enough.

Recently, sling sutures through the lid above the tarsal plate have been advised. These require an assistant for pulling the lid away from the globe or, alternatively, a thick pad must be placed at the eyebrow to act as a pulley for the sutures. It is evident that the hand of the assistant or the roll of cotton will be in the way of the surgeon.

The favorite practice for exposing the eye seems to be the placing of two horizontal sutures near the upper lid margin and one in the lower lid margin. The ends of the two upper sutures arising near the midline of the lid are crossed, the threads are grasped by hemostats, and these in turn are steadied by towel clips. In most cases these sutures provide a safe exposure of the eye.

Sometimes, however, the tarsal plate becomes partly everted and exerts pressure on the globe. This is more likely to occur in long, flabby lids with well-developed tarsal plates, particularly when, after complete paralysis of the orbicularis muscle by facial block, the hemostats exert a strong pull over a high supraorbital ridge.

Another danger may arise from the pressure on the outer canthus. The wider the lids

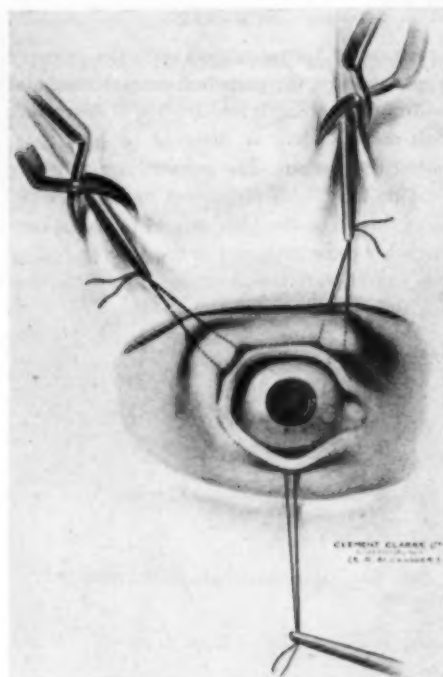


Fig. 1 (Lytton). Placing of lid sutures in cataract surgery.

are drawn apart vertically by the pull of the hemostats, the narrower becomes the horizontal lid aperture. The acute-angled outer canthus moves to the nasal side and presses on the globe, while the wider inner canthus remains firmly anchored to its attachments.

The good advice of performing an external canthotomy in these cases is rarely followed due to reluctance to create an additional wound and source of infection.

Sometimes the novocain injection into the superior rectus muscle, or the bridle suture, injures the vessels running on the tendon of this muscle. This is an additional reason for tarsal eversion. The hematoma of the fornix increases the resistance of the upper part of the lid, and a pull on the lid margin may lever this tarsal plate over this resistance. A condition is produced similar to digital eversion, where the lid is grasped by the lashes and levered over the resistance of the thumb

or glass rod placed on the upper part of the lid.

I have tried to avoid the partial eversion of the tarsal plate, and the danger arising from the pressure of the outer canthus on the globe, by placing sutures at right angles to the lid margin.

Two double-needled silk threads are inserted quite close to the lid margin, the points of entry of the needles of each suture being about five mm. apart. Thus, this length of the thread is left lying free at the lid margin. The nasal suture is placed nearer to the middle of the lid than the outer one. The four needles emerge about eight mm. higher, just at the upper border of the tarsal plate. The threads of the nasal suture run straight up, the outer threads are directed up and out as they have to pull the outer canthus away from the eyeball.

The sutures lie more subcutaneous at the lid margin and deeper higher up, where they engage the superficial fibers of the tarsus. This will prevent the lid from becoming inverted. Each pair of the threads is grasped without crossing by a hemostat, which is secured in the pincers of a towel clip.

There is no objection to the usual horizontal stitch for retracting the lower lid since the infraorbital crest is flat and the lower tarsal plate rather weak.

Obviously, these sutures are not suitable for closing the lids after the operation. They have to be removed. The lids are closed by a thread stitched through the middle of their margins and attached to the cheek.

SUMMARY

When the tarsal plate shows any tendency to partial eversion, sutures running normally to the upper lid margin are suggested. These relieve pressure of the outer canthus on the globe, give safe control of the lid, the lifting of which is assured in a plane which deviates as little as possible from the plane of the levator muscle.

10 Eaton Rise, Ealing, W. 5

METHOD OF DETERMINING THE OPTICAL CENTER OF SPECTACLE LENSES*

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It is occasionally inconvenient to use a lensometer or lens card to determine the optical center of spectacle lenses. The method to be described requires no special equipment and, in addition to the optical center, the axis of a cylindric correction can be ascertained.

First, I shall consider the optical principles involved. The use of correcting lenses gives us two spherical or cylindro-spherical surfaces, each of which acts as a corresponding type of mirror.

Let us now consider a concave lens when viewed from the front, that is, from the side away from the temple pieces. Two convex surfaces confront us, each of which will produce a mirror image of an object when that object is on the same side of the lens as the observer. The nearer surface is a weaker mirror (having a longer radius of curvature) and the far surface is the stronger mirror (having a shorter radius of curvature). Therefore, the image produced by the near surface is larger than that produced by the far surface. The images are virtual.

When this same concave lens is viewed from the rear, two concave mirrors provide the reflecting surfaces. In this case, the surface near the observer provides the real image, and the far surface either a real or a virtual image, depending on the strength of the lens and the base curve. The exact conditions belong in another discussion.

A convex lens, of course, has the strong and weak mirror surfaces reversed. When viewed from the front, the near surface is the strong mirror and the far surface the weak mirror. Therefore, the near surface provides the smaller image, and the far surface the larger. Again, when the lens is seen

from the rear, the near surface, being weaker, gives the larger image, and the far surface gives the smaller image.

The practical application of some of these principles gives us the method of determining the optical center of a lens, since the optical center may be considered the point where a line perpendicular to one mirror vertex will pass through the vertex of the mirror opposite it. The procedure to be followed is this:

A single, overhead, preferably round light is used as the object to be viewed by reflection

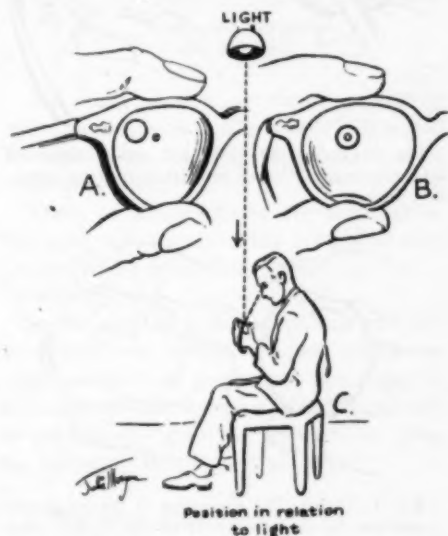


Fig. 1 (Blair). A simple, quick method of determining the optical center of spectacle lenses.

tion in the lens. The angle of reflection between the light and the eye should be as small as possible (fig. 1-C). It will usually be found best to close one eye to avoid annoying parallax. Two images will be seen (fig. 1-A). The lens is tilted so that the centers of the two images coincide exactly (fig. 1-B).

A dot with the point of a pen at this spot is exactly at the optical center of the lens. For all practical purposes, the distance between the two mirror surfaces produces no

*From Crile Veterans Administration Hospital.

appreciable shift of the optical center, even in a cataract lens.

A cylindric curve ground into the lens produces a characteristic distortion of the reflected image. The image is elongated at right angles to the meridian of greatest curvature; that is, in the axis of the cylinder.

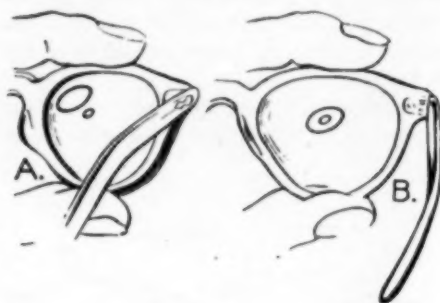


Fig. 2 (Blair). The axis and optical center of sphero-cylindrical lenses are determined by reflection images.

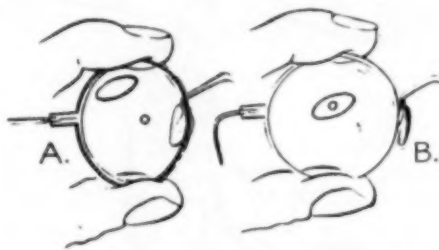


Fig. 3 (Blair). The elongation of the image will sometimes be seen better from the front; other times from the rear (fig. 2).

Depending on the strength of the lens—that is, the difference in the radii of curvature of the two surfaces and the strength of the cylindric correction—the elongation of the image will sometimes be seen better from the front and at other times from the rear.

It takes but a few seconds to try both sides (figs. 2 and 3). No calculation or transposition is necessary. Merely remember that the direction of elongation of the image lies in the axis of the cylinder whether viewed from the front or back, whether concave or convex.

In the illustrations shown, the image distortion is moderate. However, the elongation may be much more marked, or it may be so slight as to be almost undetectable.

SUMMARY

A method has been described for determining the optical center of spectacle lenses. The method is simple and rapid. Along with the optical center, the axis of a cylindric correction can usually be determined.

To find the optical center, the images of a round light source, as reflected by the two surfaces of a lens, are centered. The point where the centers coincide is the optical center of the lens. The theoretical aspects are also discussed briefly.

7300 York Road (29).

SOME PRACTICAL POINTS IN PTOSIS SURGERY*

CARL CORDES JOHNSON, M.D.
Boston, Massachusetts

For the past nine years, I have been doing a levator shortening and advancement for ptosis by an external route. The operation contains modifications of parts of many other procedures, and is based on de Lapersonne's operation.¹ So far as I can ascertain, his operation was the first levator advancement and shortening done through the skin, as opposed to the usual conjunctival approach.

I plan in the near future to report in detail on a fairly large series of cases done by myself and in conjunction with other members of the staff of the Massachusetts Eye and Ear Infirmary. Here I wish merely to mention two simple but pertinent points in ptosis surgery which have proved valuable at this hospital, and which do not seem to be generally known.

The first is that one should never clip the lashes before doing a ptosis operation. I have

* From the Massachusetts Eye and Ear Infirmary.

seen several cases of severe corneal damage which occurred in the period of regrowth of lashes that had been clipped preoperatively.

The second point is that one can avoid postoperative trichiasis or an unnatural position of the lashes and can also produce a new, natural-looking lid fold by a very simple suturing procedure.

Many ptosis operations fail to produce a pleasing cosmetic result not because the lid is raised insufficiently but simply because the lashes stand out in an unnatural manner postoperatively, sometimes actually pointing downward.

When I worked out my modification of the levator shortening operation some nine years ago, I started to use this procedure and have since applied it to other types of operation done through the skin surface, such as the Dickey and Motais. I have mentioned it previously at several society meetings.²⁻⁴ Berke has reported a similar procedure which he has applied in his modification of the classic Motais operation.⁵

The actual procedure is as follows (fig. 1):

The silk suture is passed through the lower skin edge, then into the tarsus (through the previously advanced levator in a case of levator resection and advancement) at a point high enough to put the lower skin flap on a slight stretch, then out through the upper skin edge.



Fig. 1 (Johnson). Procedure in ptosis surgery.

The suture is tied just tightly enough to approximate the skin edges well. If it is tied too tightly, the resulting lid fold tends to be unnaturally deep.

Three of these sutures are sufficient in the usual skin incision. Any remaining gaps can be closed by ordinary interrupted skin sutures.

In the case of levator resection and advancement, the sutures tend to reapproximate some of the severed levator fibers to their normal attachments in the skin, as well as producing a good lid fold and bringing the lashes up into a good position.

5 Bay State Road (15).

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KRUKENBERG'S SPINDLE*

RALPH S. RIFFENBURGH, LIEUT.

(MC), U.S.N.R.

Vallejo, California

Krukenberg's spindle is a grouping of brownish deposits on the posterior surface of the cornea, lying in a spindle-shaped mass with the long axis vertical. There is a disintegration of iris pigment, probably initiated by senile, inflammatory, or degenerative changes. That the deposition on the cornea depends on some other factor or factors which are not yet known seems likely, in view of the large number of cases with pigmentary disturbances compared with the small number that show Krukenberg's spindle.

Approximately 210 cases have been reported. In their study, including all cases reported to 1941 and 97 previously unreported ones obtained by questionnaire, Evans and others¹ found 62.3 percent of cases occurred in females. In those patients under 30 years of age, however, the percentage of females is only 38.

The youngest patient reported in whom the condition has been observed was a boy, aged 15 years. Several other youths have been reported who have developed the spindle prior to the age of 20 years. The youngest women in whom it has been seen were aged 20 years, one case reported by Evans and others,¹ and 21 years, one case reported by Bellows.²

The present case was that of a young woman, who was first observed to have Krukenberg's spindle at the age of 19 years,

and was, therefore, considered to be the youngest female yet reported.

CASE REPORT

Miss H. K., aged 19 years, was first seen on July 11, 1946, with complaints of blurring of distant vision and frontal headache. She had worn glasses since the age of six years, her present lenses for one year.

Vision without correction was: R.E., 20/56; L.E., 20/110. On refraction: R.E. improved to 20/12 with a $-1.0D.sph.$ $\ominus -0.5D. cyl. ax. 80^\circ$; L.E. improved to 20/12 with a $-1.5D. sph$ $\ominus -0.25D. cyl. ax. 115^\circ$.

No history of any inflammatory disease of either eye was obtained, nor had she been told of any abnormal or unusual condition by the ophthalmologist who had prescribed her previous lenses.

On slitlamp examination, each cornea showed, on the posterior surface, numerous fine, brownish deposits arranged in a spindle-like cluster 7.0 mm. in length and approximately 2.0 mm. in width at the widest point, which was at the approximate center of the cornea. The axis of the spindle was vertical in each eye. No cells or pigment were seen in the aqueous or on the lens capsule.

Ophthalmoscopic examination revealed only very slight choroidal stretching at the disc margins. Finger tension was low normal.

This patient has been seen twice since, at intervals of slightly less than two years. No change was noted in the corneal pigmentation. An increase of $-0.25D. sph.$ in the refractive error in each eye was the only change found since the initial visit.

U. S. Naval Hospital, Mare Island.

* The statements in this article are the opinion of the author and do not necessarily reflect the opinion or policy of the Navy Department.

I wish to express my appreciation to Dr. M. H. Post, Saint Louis, for the use of his records on the case.

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SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

January 8, 1951

DR. SAMUEL GARTNER, *president*

CORTISONE IN BOECK'S SARCOID

DR. ADOLPH POSNER AND DR. MEYER MEDINE presented a case of sarcoidosis with severe bilateral uveitis and enlargement of mediastinal lymph nodes in a 30-year-old Negress, who was treated with intramuscular cortisone for 15 weeks. The ocular lesions were of eight months' duration and, in spite of the conventional treatment, the patient's vision had deteriorated to the point where she had to be led into the hospital.

Vision improved from the first day of cortisone therapy; this was reflected in objective changes in the eyes, which became apparent during the third to the ninth week. Mediastinal lymph-node shrinkage began on the 10th day and, after one month, there was only residual enlargement of the nodes at one lung root.

A mild exacerbation of the uveitis occurred three weeks after intramuscular therapy was discontinued, but topical therapy in the form of cortisone eyedrops promptly controlled it. Some corneal scarring and a quiescent uveitis remained. The lymph-node enlargement did not recur during the six months' subsequent study. When the patient was discharged from the hospital, she was able to resume her usual daily activities.

Discussion. Dr. Gordon said that recently he had treated three cases of Boeck's sarcoid:

1. A man suffered a severe uveitis, which responded to ACTH therapy. The patient had a relapse, and was given topical cortisone. He also had enlargement of the lymph nodes.

2. A man, with a severe uveitis of one eye, was given ACTH therapy, and subsequently developed secondary glaucoma. This patient responded well to the therapy, but in three months had a relapse. ACTH was again given, and three and a half months ago the patient was discharged. At present he has just returned, with a recurrence of the condition.

3. A woman, with advanced sarcoidosis, showed scarring of the cornea, the iris was bound down, and there were precipitates on the back of the cornea. The vision was less than 1/200. After 0.5 cc. of cortisone, the vision improved to 20/70 and the cornea began to clear. One week ago, after another injection of 0.5 cc. of cortisone, the vision improved to 20/50. At present the patient is still being treated.

Dr. Gordon concluded that the response of Boeck's sarcoid to ACTH therapy was very variable.

CORTISONE AND ACTH IN OCULAR CONDITIONS

DR. HOWARD AGATSTON presented a composite report of a survey conducted by the members of the New York Society for Clinical Ophthalmology. One hundred and fifty patients were studied; 95 received the drops; 33 the intramuscular injections; 21 were treated by subconjunctival injection; one used cortisone ointment.

Most cases of allergic conjunctivitis, episcleritis, lime burn of the cornea and conjunctiva, keratitis (superficial, deep, bullous, and keratitis in herpes zoster), and uveitis responded to the drug.

Four cases of sympathetic ophthalmia and two cases of acute optic neuritis were favorably influenced. Disciform degeneration of the macula and chronic blepharoconjunctivitis did not respond. Three fourths of the 150 cases treated improved on cortisone,

while the remaining one fourth did not.

Cortisone alleviated symptoms of photophobia, pain, and tearing and appeared to shorten attacks in acute and recurrent conditions. It proved less effective in chronic states. In anterior-segment disease, the drops were effective, whereas in posterior uveitis, the intramuscular and subconjunctival routes were more successful.

None of the cases treated by subconjunctival cortisone without beneficial effect responded to intramuscular cortisone. In uveitis, subconjunctival injection of cortisone was at least as effective as when used intramuscularly.

When instillation of drops in the conjunctival sac has a chance of being effective, subconjunctival and intramuscular therapy should not be used. If subconjunctival therapy will work, then intramuscular or oral therapy should not be attempted. The judicious use of fever therapy with conjunctival instillation or with subconjunctival injection may further limit the number of instances in which systemic cortisone is indicated.

Specific therapy, antibiotics, and chemotherapy must be employed just as they were before the advent of cortisone.

EXPERIENCE WITH ACTH AND CORTISONE

DR. L. VON SALLMANN, DR. F. C. BLODI, AND DR. I. S. JONES presented their experiences with cortisone and ACTH in 49 patients treated at the Institute of Ophthalmology; 41 patients were treated with cortisone, seven with ACTH, and one with cortisone followed by ACTH. The routine course of treatment was 10 days. During this time, cortisone patients received 1,200 mg. and ACTH patients received 440 mg.

The diseases treated were: Uveitis, nine cases, five improved; chorioiditis, 15 cases, nine improved; iridocyclitis, 15 cases, 12 improved; sympathetic ophthalmia, four cases, none improved; vernal keratoconjunctivitis, one case, which improved; kerato-iritis, one case, which improved; disciform degeneration of macula, one case, no improvement;

optic neuritis, two cases, one improved; and chronic orbital granuloma, one case, no improvement.

Two cases of Boeck's sarcoid were treated systematically, but did not respond.

Dr. Jones said that a clarification of the mechanism of fever therapy has been made recently (*Arch. Ophth.*, 44:635, 1950, Ardenhorst and Falls: "Role of adrenal cortex in treatment of ocular diseases with pyrogenic substances") in which it appears that the adrenocortical response may be the salient factor.

Among the cases reported, Dr. Jones said, there were patients who responded to neither fever nor cortisone, and one who responded to both fever and cortisone. Four cases, however, after failure to respond to fever therapy, improved while on cortisone.

This observation has also been made by others. The similarities between pyrogenically induced adrenocortical response and cortisone therapy perhaps require further investigation.

It was shown by von Sallmann and Dillon that, in experimental endophthalmitis in animals, the intraocular pressure rose in those animals receiving systemic cortisone. These findings were shown graphically in a slide. McLean and Woods have observed rises in tension in patients on cortisone. Among the group of cases at the Institute of Ophthalmology, four patients had rises of tension during the course of treatment. The nature of this undesirable effect has not, as yet, been clarified.

Dr. Jones said that they had not been able to note a correlation between a drop in eosinophils in response to cortisone and improvement in the condition being treated.

Psychoses and thrombophlebitis have been observed to occur during systemic cortisone treatment and have been reported several times. For emphasis and for the sake of completeness, Dr. Jones said that, in their series, there were two cases showing psychoses and one with thrombophlebitis.

The most difficult phase of the investiga-

tion was in the evaluation of the results. The natural history of many of the conditions being treated is one of gradual amelioration or of spontaneous remissions. The desirable prerequisite of progression of the disease was not present in all their cases.

Dr. Jones then showed the following slides:

1. A case of granuloma of the iris treated with antibiotics and with typhoid without avail, which cleared during cortisone treatment. This case would be called a clear-cut beneficial effect of cortisone.

2. A case of granuloma of the iris, which also had a good result. In this case the improvement occurred during aureomycin treatment.

3. Another case of granuloma, which also regressed in a satisfactory manner, this time without any therapeutic agent.

Dr. Jones said that these cases illustrate the difficulty of evaluation even among those working on the same study. The difficulties of comparing results among the different workers in this field are of course much greater.

Dr. Jones continued with a discussion of local therapy. Sixty-five patients have received local cortisone therapy at the Institute of Ophthalmology up to the present time. This has been administered as drops, as subconjunctival injections, or as a combination of both.

The drops have been used in a concentration of five mg./cc., and have been instilled as often as hourly and as infrequently as twice daily.

The subconjunctival injections have been given in amounts varying from 1.25 mg. to 10 mg. and at intervals of three days to once a week.

Among the cases treated with local cortisone were—seven cases of vernal conjunctivitis, all of which showed improvement; five cases of phlyctenular keratoconjunctivitis, four of which showed improvement; nine cases of other assorted superficial keratitis, seven improved; seven cases of deep her-

petic keratitis, five of which improved; three cases of luetic interstitial keratitis, all of which showed improvement; 12 cases of other deep keratitis and ulcers, nine showed improvement; eight cases of lipoid degeneration of the cornea, none of which showed improvement; one case of episcleritis, no improvement; and 13 cases of iridocyclitis, five improved.

Two cases of superficial punctate keratitis did not respond to antibiotics but did respond to cortisone. Assuming a virus etiology, there is some similarity of results in this group of cases and in herpes corneae, also of virus etiology. Five of our seven cases of herpetic keratitis improved while on cortisone. McLean also has reported favorable results.

Two cases of episcleritis, one treated locally and one systematically, either did not improve or became worse during treatment. This is in disagreement with the favorable results reported by McLean.

In many cases after subconjunctival injection of cortisone, crops of superficial and deep petechias were noticed. In such cases the conjunctival vessels were dilated, tortuous, and showed segmentations of the blood column.

In four patients, a defect of the conjunctival epithelium overlying the cortisone depot was observed. This generally was only a partial defect, showing faint staining with fluorescein. In every case the healing was complete by the time the depot had disappeared.

In other patients, a residual effect was noticed at the site where the cortisone depot had lain. This took the form of a yellow, avascular, translucent thickening or nodule. These "nodules" tended to regress over several weeks' time.

In one case of recurrent acute iridocyclitis there was a rapid development of an inflammatory reaction after subconjunctival cortisone therapy. This manifested itself as a chemosis of the bulbar conjunctiva and as an exacerbation of the iridocyclitis. Both of

these conditions subsided spontaneously in 24 hours.

In conclusion, Dr. Jones said that the evaluation of the results of local cortisone treatment presents the same difficulties as the results of systemic cortisone therapy.

Bernard Kronenberg,
Recording Secretary.

OPHTHALMOLOGICAL SOCIETY OF MADRID

February 9, 1951

UVEITIS TREATED WITH NITROGEN MUSTARD

DR. EMILIANO RODA read a paper on "A case of uveitis of unknown etiology treated with nitrogen mustard." He also presented a patient who had suffered from recurrent uveitis over a long period of time and who had failed to respond to all treatments prior to nitrogen-mustard therapy. Visual acuity in this case has shown great improvement.

Following up this subject, Dr. Roda gave a masterly lecture on cortisone and ACTH.

Discussion. Dr. Lopez Enriquez said that the improvement observed in Dr. Roda's patient was evident. The pains were gone, the ciliary injection had disappeared, and she has regained considerable vision. However, as Dr. Roda himself observed, the time which has elapsed since the conclusion of treatment is too short to speak of a cure. There are still precipitates on Descemet's membrane and some other symptoms which will have to be watched before one can draw definite conclusions.

Dr. Enriquez remarked that, seven years previously, he had treated the same patient for severe uveitis of the left eye with total loss of vision. He had given her protein therapy, intravenous administration of big doses of albucid, and atropine powder locally. She recovered normal vision (with correcting lenses) and remained well for six years attending to her regular duties. This treatment, which had such excellent results

in the left eye, had practically no influence on the condition of the right eye for which he had repeatedly advised enucleation, since it was blind and at times intensely painful.

Until now little has been known about the indications for nitrogen mustard in ophthalmology. Recently, reports from North America described splendid results with this treatment in gigantic lymphoma of the eyelid.

Dr. Roda's presentation is, therefore, of great interest, and we must collaborate to learn more about the ophthalmic indications for nitrogen mustard. Especially its curative value should be compared with that of classical treatments more easily applied.

Dr. Marin Amat said that he also had treated this patient who was in his office about two years ago suffering from a hypertensive uveitis in the final stage (with pathologic cataract, occlusion and seclusion of the pupil, and no vision) in the right eye. In the left eye there was an intense exudative uveitis.

All biologic reactions were negative except the skin reaction to tuberculin which was slightly positive. At the same time there was the general appearance of status lymphaticus. Since the patient refused to have the right eye removed, Dr. Marin Amat gave her one or two retrobulbar injections of alcohol which relieved her pain. For treatment, he used methylic antigen, biweekly injections of half doses, and cod-liver oil internally. She was considerably improved. It is also worth noting that, previously, a sister of this patient was given the same treatment for the same infection in both eyes and was completely cured.

OPERATIONS FOR PTOSIS

DR. MARIN AMAT presented a paper on the operations of Motais and Horlt, done consecutively on both eyes of a patient—a girl, aged 24 years who had a congenital ptosis and at the same time a blepharochalasis in both upper lids, with complete functional integrity of the two superior rectus muscles.

The Motaïs operation was first performed on the right eye, then on the left eye, and then the Horlt operation was done on the right upper eyelid. It was at this stage that the patient was shown. Shown also were photographs before and after these various interventions to demonstrate the functional correction and the cosmetic improvement. Later he will do the Horlt operation on the left upper lid.

Dr. Marin Amat said that, in this case, he used the classical technique of Motaïs with the addition of the three slight modifications he had described in a previous communication. In the operation of Horlt, a lessening in the depth of the upper cul-de-sac of the conjunctiva of the right eye hindered placing the metallic plaque under it and prevented him from utilizing this splendid aid.

Discussion. Dr. Mario Esteban has always believed in the treatment of palpebral ptosis. Among the various operations, the most effective ones are those which use the superior rectus to supplant the levator, the basic principle of the Motaïs operation. Both muscles, placed one immediately above the other, work in the same direction, are innervated by the same nerve, and are synergists. The only objection that might be raised is that this synergism is absent during sleep.

Naturally, this operation is indicated only when the ptosis is produced by an isolated paralysis of the levator muscle. If there is no complete paralysis of the third nerve involving the superior rectus, this procedure will do no good; in fact, it would do harm in making manifest a diplopia which is now hidden by the drooping of the lid. Outside of these circumstances, where the Motaïs operation would be useless and even inconvenient, it is definitely an operation which follows the most logical anatomic and physiologic principles.

Based on these same principles, some years ago Dr. Esteban made known an original technique which he considers is better. It is really the operation of Motaïs in reverse. Instead of taking a tongue of the

superior rectus to attach to the tarsus, Dr. Esteban simply sutures the tendon of the levator to the tendon of the superior rectus.

The more pronounced the ptosis, the further the suture is placed, thus preserving the integrity of both muscles.

The chief advantage is that the traction of the lid is not confined to a single point of the tarsus but is spread over the many insertions of the levator, with its two tendons, and the cutaneous and tarsal extensions along the width of the lid.

Dr. Marin Amat thanked Dr. Mario Esteban for his brilliant discussion. In his opinion, however, the operative procedure Dr. Esteban outlined is more complicated than the Motaïs operation. He also believes that the entire width of the levator could not be inserted on the width of the tendon of the superior rectus unless the sutures were inserted in the capsule of Tenon.

Joseph I. Pascal,
Translator.

COLORADO
OPHTHALMOLOGICAL
SOCIETY

November 18, 1950

DR. WHITNEY PORTER, *president*

PROBABLE RETINOBLASTOMA

LIEUT. COL. R. CLEVELAND of Fitzsimons Army Hospital presented a six-year-old boy. This youngster had been hospitalized in July, 1949, for one month because of vomiting whole blood on one occasion. During this period he was referred to the eye clinic because the right pupil reacted sluggishly.

Fundus examinations of the right eye showed a central area of old choroiditis about two disc diameters in size and a similar lesion 0.5 disc diameter in size between the macula and the disc.

The patient was again referred to Fitzsimons in June, 1950, by a doctor in Utah with the diagnosis of tumor of the right

macula and a recommendation for enucleation. Examination then, as now, showed a white semitranslucent elevated mass of four or five disc diameters at the right macula. Blood vessels pass over it from the surrounding retina, and areas of old choroiditis are seen temporally and inferiorly to this lesion.

X-ray studies of the right globe in June and September, 1950, had shown no calcification within the eye.

Physical examination was negative. Lues and undulant fever had been ruled out. The left eye was normal with 20/20 vision. It was stated that Dr. Maumenee of San Francisco had seen this patient and felt that, since retinoblastoma could not be excluded, enucleation was advisable. The possibility of Coats's disease was mentioned.

Dr. Ralph W. Danielson pointed out that there was no crystalline reflex from the lesion as from deposits of calcium crystals. He also pointed out that no blood vessels were seen to enter or leave the mass as may occur in retinoblastoma.

Dr. Walter Fink felt this was probably a proliferative gliosis and suggested observation.

The consensus was that enucleation was advisable as the safest course.

RETINAL DETACHMENT

DR. JAMES STRONG presented a 12-year-old girl whose mother stated that the child had had poor left vision for one year. She also stated that the patient had had a forceps injury about the left eye at birth. The child had recently been nervous and complaining of headache and sick stomach.

Examination showed no pathologic condition in the right eye. Vision was: R.E., 20/20; L.E., 20/100, not correctible. A small macular degenerative change was present. In the retina of the left eye, in its inferior half, a disinsertion was seen at the periphery at the 6-o'clock position, with billowed retinal folds like cysts to either side. A white scar extended from the disc along the superior nasal artery in a broad sweeping

curve ending in fibrous tissue peripherally.

Visual fields showed blindness in the upper nasal quadrant.

The question raised was: Should this detachment be operated upon?

Dr. John Long said that, if something were not done, the eye would most likely eventually become completely blind with the possible complication of uveitis, cataract, and so forth. He felt that anything to circumvent this and preserve as much sight as possible was justified.

Dr. William Droegenmueller brought out the possibility that the recent symptoms of nervousness and sick stomach and headache might be due to the detachment which would mean that this was relatively recent and hence more amenable to surgery.

The consensus was that surgery for this detachment was indicated.

CORNEA GUTTATA

DR. B. MUIR presented two cases for their general interest. One was that of a woman, aged 27 years, with cornea guttata. The second was a case of senile macular degenerative changes in a man, aged 70 years.

CHORIORETINAL ATROPHY

DR. MORRIS KAPLAN presented a 51-year-old man in whose left eye, on routine examination, he had seen an oval lesion in the far nasal periphery. His first reaction had been that this was an elevated mass. Careful study revealed this lesion to be flat or depressed and well surrounded by pigment. The underlying atrophic choroid was visible.

The consensus was that this was an area of chorioretinal atrophy, not clinically significant.

COMPLICATIONS OF ATOPIC DERMATITIS

DR. IVAN HIX, resident in ophthalmology at the University of Colorado School of Medicine, presented a 27-year-old Spanish-American who gave a history of atopic dermatitis since the age of six years. He had also been subject to hay fever and asthma.

In 1947 he had had a left cataract removed in another city and had come to the University of Colorado Eye Clinic a year ago because of symptoms arising from left phthisis bulbi. The left eye was then enucleated.

In recent months the right vision had been failing. This was found due to an atopic cataract. While under observation for this lesion, the patient developed a corneal ulcer which did not respond to aureomycin or sulfacetamide eye drops, or to cautery, or to three weeks of cortisone eyedrops, given in 1:4 dilution in normal saline.

The lesion healed well, however, with subconjunctival injections of cortisone every two or three days for three injections. Now the cataract is dense and vision is reduced to light perception only; there has been a flare-up of his dermatitis.

Dr. John Egan then suggested that a thorough allergy survey be made.

Dr. William Droegenmueller suggested that the dermatology department be requested to supervise the treatment of the skin and that the consideration of surgery be postponed pending the outcome of this treatment.

IRIDOCYCLITIS TREATED WITH CORTISONE

Dr. Hix also presented Dr. B. R., a medical colleague, aged 24 years. This patient had entered the eye clinic on October 18, 1950, complaining of slight photophobia of the right eye with a scratchy sensation and slight pericorneal injection.

Vision was: R.E., 20/25; L.E., 20/30. Some cells were seen in the right anterior

chamber. The left eye showed no active pathologic process.

The patient gave a past history of juvenile rheumatoid arthritis for eight years with present ankylosis of the spine and involvement of the hips. He had had bilateral iridocyclitis for three months in 1941 and a recurrence in the right eye in 1947.

His treatment for the present recurrence consisted, at first, of atropine, salicylates, and heat. A thorough physical examination showed a positive skin reaction to 1:500,000 old tuberculin. This was followed eight hours later by a marked flare-up in the right eye. Brucellosis and coccidioidomycosis tests were negative.

Dental X-ray films and all other investigative procedures failed to show any new focus.

A week of the treatment already mentioned failed to give much help, so on October 27, 1950, cortisone was started giving 100 mg. systemically daily and 6.0 mg. subconjunctivally every two to three days. On October 29, there was some clearing of the sclera. On October 31, the right eye was much whiter, the aqueous showed two-plus cells, and some increased ray, and the patient felt better.

On November 4, there was marked clearing of both aqueous cells and ray and the cortisone was entirely discontinued. One week later the atropine was discontinued. The patient has returned to work. He was objectively and subjectively cured of his iridocyclitis when seen at this meeting.

Thomas M. Van Bergen,
Recorder.

OPHTHALMIC MINIATURE

The inflammation of the sclerotic sometimes accompanies, and is sometimes vicarious with rheumatic inflammation. This is not surprising, as its texture is of the same class with the ligaments of the joints.

Benjamin Travers, *Synopsis of the Diseases of the Eye*, 1825.

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THE ADJUSTMENT TO APHAKIA*

It is a matter of common observation that patients with the best possible visual result from cataract extractions show a wide difference in their ability to adapt themselves to their aphakia. A few accept their correction with avidity, step boldly forth in their new world, and their happiness and elation over their restored vision dwarfs any un-

*This editorial was written at my request by a physician who has been operated on successfully for bilateral cataracts but who prefers to remain anonymous. Derrick Vail, editor-in-chief.

pleasant symptoms they may experience. A second group, probably a majority, have various difficulties in accepting their correcting lenses and go through a period of readjustment before they finally become reconciled to their new visual status. A third group, fortunately few, are never able to wear their correcting lenses with any comfort or regularity and prefer to grope vaguely through a portion of their lives, rather than accept the accurate, but to them startling, aphakic vision. What are the reasons for these varying reactions?

The ease with which an aphakic correction is accepted appears to vary in inverse proportion to the patient's visual needs.

Thus to a patient without the need for fine and accurate perception and who does not perform manual tasks requiring exact precision of movement, the acceptance of an aphakic correction imposes no great hardship. It is also notable that this group of easy acceptors rarely complains of visual loss when they return for a later refraction review, and it is found that with their first glasses their vision has fallen materially due to changes in their refraction.

The second group comprises individuals with more acute visual needs or whose vocation or profession requires manual tasks which can only be performed if accurate vision is present. To this group the peculiarities and limitations of aphakic vision present a real rehabilitation problem which must be met by intelligent efforts toward readjustment on the part of the patients themselves, with the sympathetic cooperation of the ophthalmologist.

In the third group, fortunately small, are usually neurotic or senile individuals who are appalled, overwhelmed, and disappointed by the peculiarities and sharpness of their new vision and who temperamentally are totally unable to adapt themselves to the changed external world. They wear their glasses only occasionally, usually for reading, and prefer to wander around in a mist rather than accept their new status.

From the viewpoint of the patient, what are the problems which face him when he first receives his aphakic correction? What is his readjustment problem?

When an aphakic patient first receives his correcting lenses and finally and expectantly tests his newly acquired vision in the security of his own home among familiar surroundings, he is immediately astounded by the remarkable manner in which his Lares and Penates have suddenly increased in size. If he is aphakic in one eye only and has still some fair residual vision in the second eye, the attempt at binocular vision produces a

superimposed diplopia, the large image seen by the aphakic eye having a smaller reproduction as an inset. Useful binocular vision is impossible until the second eye is operated.

Even when the second eye is operated on successfully and tests on the Howard-Dolman apparatus show accurate depth perception, the size difference of familiar objects introduces a spatial element of false orientation. There ensues, therefore, an unpleasant period when tumblers are overturned, when, reaching for the salt, the unfortunate patient puts his fingers in the gravy-boat, flower vases are upset, ink is spilled, and other similar minor domestic tragedies occur, all exasperating to the patient and sorely trying to the members of his household.

It usually takes several weeks for the neophyte in aphakic vision to accustom himself to the magnified aspect of the outside world, forget his previous and now erroneous concepts of the size of objects, and so to overcome the false orientation. Parenthetically, there may be pleasant aspects to this size difference, as in the case of the gentleman who, in his phakic existence, has been surrounded by a group of short and somewhat rotund ladies, and in his aphakic status finds them transformed into Helens of Troy—daughters of the Gods, divinely tall and so divinely fair!

The second, and fortunately transient, unpleasant phenomenon encountered by the new aphakic is spherical aberration. At first it appears almost impossible to live in a world in which all straight lines are transformed into curves and a linear and upright world is suddenly converted into one of parabolas. This difficulty is augmented when he discovers that the movements of his eyes, which were part of his former existence, suddenly cause the curved outside world to squirm like writhing snakes. Thus the newly elected aphakic regards a door through which for years he has been accustomed to pass without misadventure and, to his amazement, he finds the jambs in each side curve in toward the middle and leave an aperture only a few inches wide at the center, through

which all reason tells him it will be impossible to wedge his portly person.

When mature thought finally persuades him that this is an optical illusion, and he timidly advances to make the test, he finds to his delight that as he approaches the opening, the curves recede gracefully and invitingly to his approach and he finds easy and unimpeded passage.

Similarly, when entering a high room with tall columns such as a hotel lobby or a railroad station, he finds the supporting columns bending and waving precariously and he is immediately convinced that by trespassing in such a manifestly shaky edifice, he will accentuate the instability and invite disaster. He fears that he will emulate Samson at Gaza, where in revenge for the loss of his own eyes, Samson precipitated the entire structure on the heads of jesting Philistines, and incidentally upon his own!

Gradually he learns the secret of persuading the outside world to remain in a properly upright position and abandon its sinuous behavior. The secret consists in holding his eyes motionless, his gaze fixed through the optical center of the correcting lens, and to move his head slowly to look at any desired object not in his direct view. When this simple trick is mastered, the spherical aberration disappears, and, once gone, can only be elicited and reproduced with difficulty.

With mastery of false orientation and spherical aberration, the next step in the thorny pathway of the new aphakic is the coordination of manual movements with the new visual imagery. The most elementary tasks—sharpening a pencil, carving a fowl—are done only with a sense of insecurity and clumsiness. It seems hopeless to the victim of cataract surgery that he will ever recover his former feeling of confidence or achieve again any manual dexterity for a technical procedure. Nothing can restore his confidence except constant practice. Self-assurance and the cajolery of his friends and admirers are unavailing. There is nothing to do except

patiently repeat some manual task until confidence is again regained.

For many patients small jig-saw puzzles, Japanese block puzzles and the like, are of decided value, teaching the individual how to handle objects and at the same time tickling his ego with a sense of accomplishment when the puzzle is solved.

One aphakic surgeon met the problem in a peculiar way. Fortunately, this individual lived during the summer on the water where crabs were plentiful and he himself has a weakness for their succulent meat. The picking of a hard-shell crab can either be a rough-and-ready procedure accomplished with a hammer, a gouge, and one's teeth, or it can be promoted to the level of a surgical operation, carefully removing shell, cartilage, and cell membranes without damage to the underlying meat and excavating each cell thus opened with the same precision a dentist would clean out a cavity.

The industrious pursuit of this latter procedure occupied the surgeon several hours each morning, resulted in a steadily improving coordination between manual manipulation and his new visual perception, and provided a steady supply of fresh crabmeat far beyond his household's capacity to consume. Thus, when the news spread through the neighborhood that a daily supply of free and surgically-prepared crab meat was available for the asking, the surgeon suddenly found himself enjoying popularity of a degree never before or since attained.

Thus the newly created aphakic can be assured that his three most obvious troubles—false orientation, spherical aberration, and lack of coordination—can ultimately be overcome with time and practice.

There remain two other difficulties that no amount of time or practice can ever overcome and which must be endured as perpetual crosses. These are the limitation of the visual field due to the ring-scotoma and the continual but necessary adjustment of the aphakic correction.

It is well known that the magnified central visual field seen through the optical center of the glass overlaps and blots out a portion of the dimmer peripheral field and so produces a ring scotoma, which at 33 cm. subtends an area from about 35 to 55 degrees depending on the size of the spectacle lens. At ordinary reading distance, with a field of approximately 70 degrees or 40 centimeters in diameter, the aphakic is unconscious of the scotoma. Beyond 20 feet the field is also sufficiently wide to permit driving a car and the scotoma presents no problem. For intermediate distances, especially between two and 10 feet, the presence of the ring scotoma imposes a social handicap which cannot be overcome.

In ordinary group conversation, faces pop in and out of the blind area with the annoying insolence of a jack-in-the-box. Constant collisions with chairs or individuals inconsiderately injecting themselves into the blind field become a matter of course and a string of apologies becomes automatic. Going up and down stairs the aphakic must look at the steps to avoid falling and to learn when to stop ascent or descent, but this is at the expense of colliding with any innocent stranger who is thoughtless or reckless enough to be going in the opposite direction.

Crossing a street with a green light the unfortunate aphakic is at the mercy of any motorist who chooses to turn into his pathway. He can well sympathize with John Hunter who said of his own cardiac pathology, "My life is in the hands of any rascal who chooses to worry me." This infirmity cannot be cured; it must be endured. All the aphakic can do is to throw himself upon the mercy of his friends—but without asking for sympathy!

The second difficulty is the annoyance of cataract glasses. Volumes have been written on the aphakic correction and few have contributed materially to the solution of the problem. With each individual, within certain limits, the selection of the best lens for

his individual needs is largely a trial-and-error procedure. There are certain general principles which unfortunately are learned only through bitter personal experience.

First, the greater the base-curve of the correcting lens the larger the visual field, but the greater and more troublesome the peripheral spherical aberration and the less useful the enlarged field. Within the average $+10.0D.$ sph. to $+13.0D.$ sph. range, a $-3.0D.$ spherical base curve affords the best compromise.

Second, for the bifocal addition, ignoring all arguments over indices of refraction, the flat or square top segment is vastly preferable to a spherical or rounded addition. The aphakic invariably prefers the upper portion of his add, avoiding use of the lower portion on account of prismatic deviation and peripheral spherical aberration incident to the strong plus lens. For this reason, the trifocal lens is of little value, the lower and stronger add is so low it is almost useless.

Third, the glasses must be accurately centered and adjusted. Since the optically active aphakic uses only the optical center of his lens, any maladjustment of the pupillary distance introduces at once a prismatic error which greatly reduces visual efficiency. Similarly, a fraction of a millimeter in the vertical adjustment produces a similar error and, since the aphakic uses only the upper portion of his add, if one lens is a fraction of a millimeter lower than the other, the aphakic may suddenly find he is using only monocular vision for his close work.

Lastly, the difference of less than a millimeter in distance of the lens from the anterior surface of the cornea may make a difference of almost a diopter in the refraction, depending on the strength of the aphakic correction. After the correcting prescription is filled and adjusted by the optician, the patient must again be seen by the ophthalmologist to determine if the finished and adjusted glasses give the maximum of vision, or if one lens must be set in or set out.

And so at long last the aphakic's refraction correction has become stabilized, his glasses have been properly fitted and adjusted, he has overcome the difficulties of false orientation, spherical aberration, and manual coordination. He is now launched forth on his aphakic career for the remainder of his days, and, barring his difficulty with his visual field limitation, all is supposed to be well. But alas, he has one more constant worry. His glasses do not stay adjusted. He puts them down every time he bathes or washes his face, he gropes for them, often in an unaccustomed place, to put them on again. Frequently they are knocked into the wash bowl or off the bathroom shelf in his efforts to recapture them. They rarely or never break, but they constantly become bent out of adjustment.

When this happens, his only resource is to have on hand a supply of spares and, when reduced to his last pair of adjusted lenses, to seek the aid of a friendly and skillful optician, have the entire works readjusted, and then begin all over again. By following this procedure, provided the bridge of his nose and the back of his ears can tolerate the weight of his correcting lenses, he can win through to a life of comparative activity and visual comfort.

From the viewpoint of the ophthalmologist, the postoperative troubles of an aphakic present a duty and an interesting problem. The duty of the ophthalmologist is to advise the new aphakic of the difficulties which lie in store for him and how best to meet the readjustment problem. The problem concerns the elderly individual without great visual requirements whose vision is reduced only to the 20/70 or 20/100 level. Is it proper to subject him to the visual and physical reorientation incidental to aphakia for the sake of the improved central visual acuity? The question is a pertinent one and cannot be answered yes or no. It is an individual question with every patient and should be carefully considered by the ophthalmologist on the basis of the individual's visual re-

quirements and his physical and mental status before surgical interference is advised.

CLINICAL CONGRESS OF THE AMERICAN COLLEGE OF SURGEONS

SURGICAL COLOR TELEVISION

The 37th annual clinical congress of the American College of Surgeons was held in San Francisco November 5th to 9th. It was an extremely successful meeting in every respect.

The scientific sessions on ophthalmology were very well attended, with good representation from the entire Pacific Coast and the adjoining states just beyond the Sierras. The sessions were held at night, which permitted the men to attend the various clinics during the daytime and do some sightseeing.

The first evening there was a symposium on injuries of the eyes and adnexa, with Meyer Wiener of Coronado in the chair. Contusions were discussed by Michael Hogan of San Francisco; lacerations of the eye and adnexa were discussed by Harold Scheie of Philadelphia; chemical burns of the eye were presented by Ralph McLaughlin of Charleston, West Virginia; thermal burns by Brendan Leahey of Lowell, Massachusetts; secondary repair of fractures by John Converse of New York; and the final speaker, Edmund Spaeth, discussed repairs of chemical and thermal burns.

On the second evening, Frederick C. Cordes presided at a symposium on cortisone and ACTH in ophthalmology. The action of cortisone in ophthalmic conditions in general was discussed by Rodman Irvine of Los Angeles, while their local use in ulcers was presented by Phillips Thygeson of San Jose, California. The local use of ACTH and cortisone in burns was discussed by Irving Leopold of Philadelphia, and Moacyr Alvaro told of his experiences with the drugs in Brazil.

Following both of these symposia there

was a very interesting question and answer period that brought out some valuable information.

On the third evening, the meeting was presided over by James N. Greear of Reno. At this session Kenneth Swan of Portland presented his experiences with tumors of the retina; Dohrmann Pischel discussed some technical points in the surgery of retinal detachment; David Harrington of San Francisco commented upon late vitreous complications following intracapsular cataract extraction; and Otto Barkan of San Francisco reviewed the present status of goniotomy.

Of special interest was the surgical color television program carried out under special arrangements with Smith, Kline & French Laboratories. The surgery was done at Letterman Army Hospital and televised to the Larkin Hall in the Municipal Auditorium. Here there were 16 television sets in front of which there were chairs. Two afternoons, from 1:30 to 3:00, were devoted to ophthalmic surgery. The surgery was done by the consultants of Letterman Army Hospital and staff members of the Universities of California and Stanford.

The first day, due to some technical difficulties, only three operations: an enucleation with magnetic implant, a cataract extraction, and a squint case, were telecast. On the second day, a cataract extraction, a muscle transplant for lateral rectus paralysis, corneal tattoo, and a congenital ptosis operation were all performed within the given time. By having some of the preliminary surgery done, such as exposure of the muscle, before the case "went on the air," and having the case go "off the air" when the conjunctival sutures were started or the sutures were tied in cataract extraction, it was possible to have a "live telecast" for practically the entire allotted time. There was widespread interest in these color telecasts.

At the present stage of development of color telecast the pictures seen are not so good as a well-made movie. But with further improvement it may well supplant movies,

as in a "live telecast" nothing is deleted and the difficulties and complications that may arise are seen as well as the methods of meeting these complications, a valuable part of the telecast. The running comments, which it was found were best done by an assistant who was thoroughly familiar with the procedures and the operator's technique, added a great deal to the value of the telecast.

The observation of eye surgery by a group of onlookers in an operating room is highly unsatisfactory. With the telecast it makes it possible for everyone to see the details with equal facility. It is not difficult to picture future instruction courses in surgery to larger groups of ophthalmologists being successfully carried out particularly when the technique of telecasting and the equipment have been further improved.

Due to the fact that the meeting of the American College of Surgeons very closely follows the meeting of the Academy, there is usually a rather small, primarily regional, attendance of ophthalmologists. One of the functions of the American College of Surgeons should be to keep its ophthalmologist members abreast of the newest procedures in ophthalmic surgery. If it maintains its program up to the high level established this year and expands its broadcast of "live" surgery, there can be no doubt of the fact that there will be a marked increase in attendance of ophthalmologists.

One cannot leave these comments without congratulating Smith, Kline & French Laboratories for their pioneering work in this field of surgical color telecasts. A word of thanks also goes to Dr. Robert White of the University of Pennsylvania School of Medicine for his work as television coordinator.

Frederick C. Cordes.

SIR STEWART DUKE-ELDER

The weekend of September 14, 1951, was a memorable one for San Francisco ophthalmologists and others privileged to attend the

Sixth Francis I. Proctor Lecture, delivered by Sir Stewart Duke-Elder at the University of California School of Medicine. Toland Hall was crowded and the brilliant presentation was the highlight of the annual study course instituted by the department of ophthalmology under the able administration of Dr. Frederick C. Cordes.

The subject was "The phasic variations of the ocular tension in primary glaucoma," and, according to Sir Stewart, variation in ocular tension in any individual is more extensive and irregular than is generally appreciated, and like the variable in a formula relating factors influence ocular tension.

This tension variation has been ingeniously utilized to determine the site of the causative pathologic process in glaucoma. Fluorescein concentration in the anterior chamber brought to the desired known level by conjunctival instillation on the one hand and by intravenous injection on the other, is observed during periods of greatest rise and fall of pressure. Concurrently the venous pressure and concentration of fluorescein in the aqueous veins are observed.

From correlation of all observations Duke-Elder concludes that, in chronic, simple, wide-angle glaucoma, there is no increased secretion of aqueous but rather diminished outflow due to reduced elimination through the venous system draining Schlemm's canal.

The Proctor Lecture is published in this issue of the JOURNAL. For this reason it is unnecessary to say more about the content, fearing inaccuracies in representation or interpretation. However, it should be pointed out that the methods used for this study will, no doubt, be correlated with Grant's method of determining resistance to aqueous outflow and, as a result of the two attacks on the problem, we are entering a new era in the understanding of glaucoma.

The morning after the Proctor Lecture Sir Stewart conducted a clinic at the University Hospital, discussing a series of problem cases in his inimitable fashion, to the delight

and enlightenment of those present. The distinguished guest objected to being called a foreign guest, and rightly so, since his texts are the bibles of all of us who read English.

After a dinner, with credit to Dr. Clifford Dickey for the arrangements, Sir Stewart reviewed informally some of the projects now underway at the Institute of Ophthalmology of the University of London.

The scientific panorama disclosed such diverse endeavors as work on plastic cataract lenses; long-term research on myopic families; anatomic demonstrations of the extensive venous network into which Schlemm's canal empties; startlingly accurate pictures of venule capillary aneurysms in diabetes, demonstrated through a new technique of injecting retinal vessels; new ideas on antibiotics and the permeability factors determining their distribution; the use of polymyxin-E in control of pyocyanous infection; fascinating investigations attempting to show how cortisone inhibits inflammatory reaction; factors affecting the permeability of the epithelium and endothelium of the cornea, in relation to corneal transparency; dramatic experiments in electrophysiology, taking action currents off retinal ganglion cells and other retinal receptors, showing how these may be altered by ocular movements; and on and on into the evening, to the complete amazement of the listeners who sat enthralled at the extent, the uniqueness, and the ingenious originality of the program.

Reflecting upon the extraordinary progress in fundamental ophthalmic research going on in England causes one to wonder if, under a scheme of socialized medicine, brains can be more readily bought and creative ability better stimulated to produce in this almost "mass production" manner than under the system of universities free from government control. I think not for, fortunately, in spite of the circumstances which prevent the continuation of "the foundation" which has been our standby as a substantial source of private financial aid, we still have in our country corporate enterprise which

can, legally, in an organized manner, support the universities from which flow fundamental knowledge.

I decided that Sir Stewart's brief review of the research activities at the University of London demonstrated not the power of financial security derived from government financial support but, instead, the power of one individual to organize and direct his subordinates and inspire them to produce when this individual is imbued with the sound scientific philosophy possessed by Sir Stewart Duke-Elder. This philosophy, expressed in an address to the American Ophthalmological Society in 1946, warrants repeating here, for I am convinced that it explains the incomparable success he has achieved at the Institute of Ophthalmology of the University of London.

"It may be said that the advances of which I speak are physiologic rather than clinical. But advances in the practice of medicine can only go as far as the fundamental sciences on which they are based have advanced. That, I think, is the most hopeful aspect of the matter, for it may be that we are at last approaching a stage when a *science* of ophthalmology may begin to emerge. By that I mean an organized system of knowledge dealing with first principles upon which a study of disease can be philosophically based.

"The defect of ophthalmology at its present stage of development is that it is too compartmentalized, lacking an ordered sequential philosophy of cause and effect. Observational ability is indeed plentiful, but the wisdom required to assess the mass of observations is at a much higher premium. . . . Each new disease that appears in the literature is not a new morbid entity discovered as Columbus discovered America. It is merely the recognition of a reshuffling of the basic reactions of the tissue cells; and, although the disease-pictures are artificial and ephemeral, if we go deeply enough, the underlying basic reactions to disease are perpetual and always remain unchanged.

"So, too, with research: it is yet in large measure the making of a mass of observations, most of them disparate, with too little of the philosophy of synthesis and integration. For too long we have been forced to accumulate masses of apparently unrelated facts which swell beyond all reason a vast literature. As yet, they await adequate interpretation and integration into a body of coherent thought. As the pile of information gets higher we require more and more time to acquaint ourselves of it and have less and less time to think about it. Like George Bernard Shaw we shall require to go back to Methuselah and live for 400 years if we are able to be really wise, unless someone can find the common denominators, the basic generalizations by which our vast knowledge can be synthesized into a coherent scheme. This stage may not be so very far away. And even if our first schemes are temporary—partly or even largely wrong—they will certainly serve a useful purpose if they merely act as a scaffolding for further constructive building. . . . Research is not an easy thing to start and, apart from individual brilliant exceptions, the student requires to be inspired by teachers who themselves have grown up in the stimulating atmosphere and philosophic background of research."

Sir Stewart Duke-Elder is certainly a teacher who grew up in the stimulating atmosphere and philosophic background of research, free from government control. He is making the most of government subsidy of medicine, and was fortunate enough to be in a unique position when the system went into effect wherein he could dictate to politicians with regard to the running of his institute.

The questions are:

Will the men he is training be as free to develop and follow their own research inclinations as was their teacher?

And, more important: Under the system of socialized medicine, will enough men from the next generation be attracted to the profession to make it probable that the exceptional man will be found among them?

For, upon finding the exceptional man depends the future of medical progress.

S. Rodman Irvine.

CORRESPONDENCE

THE M.D. DEGREE OF NORWAY

Editor,

American Journal of Ophthalmology:

In the account of the professional career of Schiøtz written on his centenary it was noted that he graduated as bachelor of medicine in 1877 and received his M.D. six years later after submitting an acceptable thesis (February, 1950, issue of the JOURNAL). At the International Congress of Ophthalmology many colleagues from America and Great Britain expressed interest in the ancient attitude that the Scandinavian countries still maintain in bestowal of the degree of M.D.

The regulations governing the award of the Norwegian degree are in a printed brochure. The degree is conferred by the senate of the university on the advice of the medical faculty which is at the University of Oslo. Honorary M.D. degrees may be given foreigners.

The native applicant submits a dissertation written in Norwegian or other approved language accompanied by his university grades and a list of his previous contributions. After the essay is approved, 50 copies must be transmitted to the university, either in regular printing or the offset method, but mimeographing is not permitted. No treatise is acceptable that has been published over a year before or has received a university medal or has been an examination requirement.

If the thesis is deemed unworthy, the candidate must wait two years before presenting another. The M.D. can be refused those guilty of misconduct such as drunkenness, but none has ever needed to be barred on such charge.

The candidate is then required to give

two public lectures—the first on a topic of his choice and the second on an assigned topic for which he is allowed 10 days' preparation. Finally comes the public defense of his dissertation. The dean of the faculty serves as moderator, leads the discussion, and sees that the proceedings do not extend over six hours. Two opponents appointed by the faculty deliver a detailed critical analysis before and after its presentation respectively. The preliminary decision rests on the faculty or more often on a committee of censors nominated by it who render judgment on the lectures, the thesis and its defense, but the final verdict is made by the senate of the university.

The M.D. diploma entitles the recipient to give lectures at the university, but only so long as he does not abuse the privilege and continues innocent of misconduct. Only five percent of the medical men of Norway have acquired the M.D. degree. Many have obtained the degree in Germany or France or have received honorary degrees from German universities. A candidate hesitates to risk that the censors and the university senate are sufficiently conversant with his subject, or that political factors may not occasionally sway the opinion.

(Signed) Georg W. Keyser,
Oslo, Norway.

"HORNER'S SYNDROME: AN AMERICAN DISCOVERY"

Editor,

American Journal of Ophthalmology

Under the title, "Horner's syndrome: An American discovery" (Bull. Med. Hist., May-June, 1951, pp. 284-289), Bruno Kisch has drawn attention to the clear definition of a syndrome distinctly reported and published by S. Weir Mitchell as early as 1864 in Mitchell, Moorehead, and Keen's reports of their attentions, at the Union Army Hospital, Philadelphia, to Union soldiers who had been sent to them because of wounds in their necks. Their reports antedate Horner's arti-

cle in the Monatsblatter of 1869, vol. 7, p. 193, the title of which considered the symptoms to be those of a "ptosis."

In Mitchell's classic volume *Injuries of Nerves* details are complete as we recognize the lesions today. Mitchell states in this volume, published in 1872, that his attention was drawn to a soldier who had been wounded in the neck by a missile which passed in one side and out the other, and he casually noticed the contracted pupil of the right eye and, later, he reported the droop of the lids and the slight sinking of the globe on that side.

This is but a brief outline of what must be of great interest to ophthalmologists.

In a perusal of Kisch's article, one very naturally would inquire something about Mitchell's contribution to American medicine and especially of his valuable interests in ophthalmology. A great debt is owing to him. The present generation is inclined to regard him as a medical man interested in general literature, as he has written a number of novels and a volume of acceptable poetry, besides having instituted and practiced what is known as a "rest cure." An adequate biography remains to be written. Those which are now available concern chiefly his articles in general literature.

(Signed) Burton Chance,
Philadelphia, Pennsylvania.

BOOK REVIEWS

OCULAR SURGERY. By J. Meller, Vienna, Austria. Sixth edition, revised by J. Böck, with the collaboration of K. Kofler. 494 pages, 281 tables and figures.

This is not just another book on ophthalmic surgery. It is not just a textbook which summarizes all known methods of surgical procedures. It represents the experience of one man who has been, and is still, an outstanding surgeon and teacher. It describes for the ophthalmic surgeon the surgical methods as tried, executed, and approved at the author's eye institute in Vienna, Austria.

The steps of every single operation are discussed in detail, the advantages and disadvantages of each step are outlined, and the consequences of every possible mistake in judgement or technique are explained, a fact which makes this volume especially instructive for the beginning practitioner for whom it was originally written.

The book is divided into 17 chapters. The first six are devoted to the surgery of the lacrimal apparatus and the lids. The eighth chapter deals with strabismus; the ninth with surgical procedures of the orbit, including enucleation. Chapters 10 and 11 describe extracapsular and intracapsular cataract extraction, linear extraction, needling, and iridotomy.

Chapter 12 is devoted to glaucoma. Optical iridectomy, conjunctival flaps, and the surgical procedures in iris prolapse, anterior synechia, iridodialysis, and iris cysts are described in chapter 13. Perforating and lamellar keratoplasties are the topics of chapter 14. The handling of retinal detachment, the localization of retinal tears, the indication and the selection of the different surgical procedures for retinal detachment are discussed in chapter 14. The last two chapters deal with intraocular foreign bodies, vitreous surgery, radium treatment, minor lid and corneal surgery, and instructions for anesthesia.

The prefaces to the first and fifth editions are reprinted and the author contributes a short introduction to the present edition.

The format of this volume is excellent and so are the numerous illustrations. The reviser, Dr. J. Böck, has refrained from projecting his own personality into this new edition and has so preserved its original character, in spite of the additions and changes he had to make in order to include the achievements of the past years.

The reviewer cannot help wondering, however, why some surgical procedures which are definitely out of date were not omitted, also why the surgery on the vertical muscles was not even mentioned.

In spite of these minor objections, this book will continue to be a valuable addition to the library of every eye surgeon, just as it has been a favorite ever since its first publication in 1918.

Alice R. Deutsch.

ATTI DEL 38. CONGRESSO DELLA SOCIETÀ
OPTALMOLOGICA ITALIANA. Rome, Arte
della Stampa, 1950, v. XI.

The physiology of the cornea was the principal subject of discussion at the 38th meeting of the Italian Ophthalmological Society which was held in Taormina, October, 1949. The main papers were presented by members of the University of Catania.

In his introduction G. Favarolo gave a survey on the various theories of the physiology and pathology of Descemet's membrane and the endothelium. He pointed out that a pathologic change of the endothelium may be due not only to degenerative processes (kerato-endotheliosis) but also to inflammatory conditions (kerato-endothelitis).

The most important report was made by G. Scuderi who only recently has published an excellent monograph on corneal permeability. He dealt with many aspects of corneal physiology. In discussing the water exchange of the cornea he objects to both Cogan's and Davson's dynamic theories of a flow of fluid out of or into the stroma. On the basis of his experiments with aniline dyes he believes that there is no exchange of water between the corneal stroma and the tears or the aqueous. He gave a short survey of the nutrition and respiration of the cornea and dealt more extensively with corneal permeability. The epithelium has a selective permeability; Descemet's membrane is pervious but the endothelium is pervious only for a flow from the stroma toward the aqueous, but is a barrier in the reverse direction.

A. Bonaccorsi reported on the influence of the temperature on the corneal permeability; a solution of a mydriatic penetrated best at 16°C.

From the University of Pavia came several papers on the experimental use of some new drugs.

G. B. Bietti reported for the first time on the experimental use of thiosemicarbazone (Domagk's Tb I/698, Conteben) in ocular tuberculosis. He found this new drug superior to streptomycin and PAS whether these are applied alone or combined.

In the transactions of the Ophthalmological Society of the Lombardy, which are included in this volume, Bietti and F. Cartasegna described their results in the experimental and clinical use of PAS in ocular tuberculosis.

C. Brognoli studied the penetration of PAS into the eye. He found the highest concentration in the aqueous after systemic administration of the drug. After local administration this concentration was much lower, but it could be enhanced by adding hyaluronidase to the drug. But even then the PAS level in the aqueous is low compared with the level after systemic administration. The last mentioned experiments were done in collaboration with A. Giarlini.

M. Azzolini and S. Faldi studied the tolerance of the eye to aureomycin when injected into the aqueous or into the vitreous of rabbits. Severe inflammatory reactions followed intravitreal injections. Up to 1.5 mg. aureomycin was tolerated when injected into the aqueous.

The effect of tetraethyl-ammonium on the eye was reported by V. Cima. He found the intraocular pressure lowered after the administration of this autonomic ganglia-blocking agent.

M. de Vincentiis reported on the distribution and metabolism of nucleic acids in the retina on the basis of his histochemical studies.

M. Focosi and P. de Muro succeeded in producing a thrombosis of the central retinal

vein on an allergic basis. They injected lamb serum intravitreally in sensitized guinea pigs.

E. Tosti and F. Leonardi made an extensive study on the damage and recovery of the corneal sensitivity after various operations. They constructed their own ingenious apparatus.

Among numerous papers on operative procedures is C. Persichetti's report on the usefulness of the cyclodialysis. The author used this operation not only as an antiglaucoma procedure, but also to sever anterior synechias, to loosen an incarceration or prolapse of the iris after a corneal wound, to extract a foreign body or even a cataract.

R. Campos described his goniodialysis combined with a basal iridectomy. In another paper he maintained that an interruption of neuro-vascular reflexes explains the effect of his operation.

F. Contino found a neurinoma of the iris in a patient with no signs of Recklinghausen's disease. The report is well illustrated and the bibliography is exhaustive.

E. da Pozzo reported a case of acute keratoconus which occurred during pregnancy and regressed after pregnancy was interrupted. G. Renard, M. David, and L. Rigaud continued their study on the acute edematous intracanalicular optic neuritis. They dealt with the difficult differential diagnosis and advised decompression surgery.

In this volume are included the transactions of the first meeting of the Latin Ophthalmological Society. This new society aims to connect more closely the Latin-European and Latin-American countries. The papers are in French.

The transactions of the Ophthalmological Society of Lombardy contain, among other reports, a study by F. Morpurgo and L. Ferrata on the respiration of the cornea before and after transplantation. They found that a clear transplant has the same oxygen consumption as the normal cornea. An opaque transplant has a much higher oxygen consumption. They also read a paper on the

histology of corneal transplants. E. Oxilia studied the effect of ultrasonic waves on the isolated rabbit cornea. G. C. Urbani found not only fundus changes but also a cataract in a case of diver's disease.

The cases presented before the Ophthalmological Society of the three Venetian provinces include the report on an oligodendroglioma of the retina in a 74-year-old man by E. Sipala.

Among the papers read before the Ophthalmological Society of Tuscany, Umbria, and Emilia is a report by C. Francia on another patient with corneal lesions in Hodgkin's disease.

Frederick C. Blodi.

TRANSACTIONS OF THE SOCIÉTÉ FRANÇAISE D'OPHTALMOLOGIE, 1950, v. 63, pp. 1-328.

During the scientific sessions of July, 41 papers on various topics were presented. The main report on night vision and its disturbances, given by G. E. Jayle and A. G. Ourgaud, is not included in this volume but is published as a monograph (Reviewed: *Am. J. Ophth.*, 34:644 (April) 1951). The discussion on this report shows that it is a most comprehensive review on this specific field of ophthalmology.

H. Goldmann showed his new automatic adaptometer and R. Weekers demonstrated a modified self-registering perimeter for the examination of the light sense in every part of the visual field. Both are made by Haag-Streit, Lieberfeld, Berne.

N. Matavulj describes the changes of unilateral stasis and the physiologic process that brings it about.

H. Chavanne and M. Devic call attention to the appearance of retinal hemorrhages and their possible prognostic evaluation in intracranial aneurysm. Petit-Dutaillis and Guillaumat emphasize the importance of sphygmomanometry of the retina in surgery of the intracranial vessels. P. Bregeat and M. David believe that arteriography of the caro-

tid is very useful in the differential diagnosis of basal lesions because it gives information on the condition of the internal carotid and its surroundings.

The dissociation of the corneal reflexes, the tonus of the orbicularis, hypotony of the globe, a pendular nystagmus, mydriasis, and areflexia of the pupils are signs of a severe lesion of the brain stem as analyzed by A. M. Larmande, with many revealing details.

L. Paufigue, P. F. Girard, and R. Etienne presented a paper on diseases of the cervical disk and retrobulbar neuritis. They explain the retrobulbar disturbance on a vasomotor basis, namely by a contusion and irritation of the vasomotor fibers in the anterior roots by the dislocated cervical disks and stress the fact of a definite clinical relationship on one hand and the uncertainty of the exact mechanism on the other hand. They quote four corresponding case histories. Cervical traction brought immediate improvement of vision and is recommended as the treatment of choice.

L. Dolcet-Buxeres studied the histology of the retina in a case of Tay-Sachs's disease in a child of non-Jewish extraction, whose grandparents were first cousins. Besides the degeneration of ganglion cells and nerve fibers, he also found severe irregularities in the internal nuclear layer.

C. L. Schepens read a paper on inflammation of the ora serrata and its complications and he showed his new stereoscopic ophthalmoscope and a special instrument to depress the ora. The ophthalmoscope is carried on a head band and gives an inverted image. The small depressor consists of a thimble with a little hook and a foot plate.

Bonamour, J. L. Bonnet, and Buovolo mention a special form of retinopathy which they call dysoric retinopathy. The name dysoria was invented by Schurmann and MacMahon in general pathology to denote a severe damage in the endothelium of the capillaries and subsequent disturbance in the blood-tissue barrier. The retinopathies

in anemia, septicemia, and cachexia, following debilitating diseases, are included in this group. Cerebral complications are not unusual.

Calmettes, Darnaud, and Deodati stress the importance of the lipotropic factor in the pathogenesis of diabetic retinopathy. Dollfus discusses a case of lupus erythematosus with retinal lesions. J. Sedan and S. Sedan-Bauby mention the peculiarity of retinal hemorrhages in Eales's disease, never to appear again in exactly the same location and they describe the retinal atrophy following those hemorrhages.

A. Fritz read a paper on retinal hypotension and his experiments in finding the lowest tension in the retinal artery which the retina could survive.

Mme. Sedan-Bauby reports on the chances of nonsurgical treatment in retinal tears with detachment, and describes a case in which the detachment occurred after the electrocoagulation of such a tear, which otherwise had been unchanged for three years. This paper was the object of a vivid discussion concerning the indication for early surgery or no surgery at all in retinal tears without detachment and on the importance of distinguishing between round holes and v-shaped tears in the prognosis.

Ch. De Jean draws attention to the fact that a retinal tear might be covered by its lid and, in this way, be easily overlooked and that it is very important to look for this type of tear, especially in the superior fundus periphery.

A. J. Bedell, Albany, New York, showed a series of beautiful slides in the follow-up study of a case of angiod streaks, 17 of which are reproduced on a plate in color.

The importance of gonioscopy in the differential diagnosis of glaucoma in rubeosis iridis, and in glaucoma following the thrombosis of the retinal vein, was stressed by J. François in a paper of unusual interest.

Alice R. Deutsch.

ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

5

DIAGNOSIS AND THERAPY

Scheie, H. G., Tyner, G. S., Buesseler, J. A., and Alfano, J. E. **Adrenocorticotrophic hormone (ACTH) and cortisone in ophthalmology.** *A.M.A. Arch. Ophth.* **45:** 301-316, March, 1951.

Results in the treatment of 55 eyes with cortisone or ACTH administered systemically and of 69 eyes where cortisone was administered locally in the form of drops are presented. Systemic therapy with these hormones is best suited for acute lesions, since ACTH and cortisone can be given for only a short time owing to the danger of undesirable physiological side effects. Local use of cortisone is effective only in the treatment of lesions of the anterior segment but is advantageous because the drug can be administered over a long period. No ill effects from the use of cortisone in the form of drops have been observed even when the instillations were made over a period of several months. The mechanism of action of these hormones is not yet known, but they apparently block response to various types of allergens and anaphylactins as well as the effects of inflammation and

some chemical irritants. The underlying allergic state is unaffected, however, and persists unchanged after withdrawal of treatment.

Cortisone and ACTH given systemically were effective in the treatment of acute focal choroiditis and endophthalmitis phacoanaphylactica. Somewhat encouraging results were obtained in the treatment of acute non-granulomatous uveitis and interstitial keratitis. More questionable benefit was obtained in the treatment of retrolental fibroplasia, optic and retrobulbar neuritis, and as postoperative therapy after keratoplasty. No improvement was noticed in the treatment of chronic granulomatous uveitis, Harada's disease, angiospastic retinopathy, Tay-Sachs disease (infantile amaurotic familial idiocy), or thyrotoxic exophthalmos. Encouraging results with local therapy were observed in the treatment of acute nongranulomatous anterior uveitis (iridocyclitis), endophthalmitis phacoanaphylactica, iritis due to retained lens material following attempted intracapsular extraction, syphilitic interstitial keratitis, sclerosing keratitis, superficial punctate keratitis, marginal keratitis, chronic keratoconjunctivitis due to

bacterial allergy, phlyctenular keratoconjunctivitis, atypical vernal conjunctivitis (allergic), and episcleritis.

E. J. Swets.

Schiff-Wertheimer, Jonquères, J., and Martin, G. **Twenty-five cases of serious eye diseases treated in a sanatorium in Digne.** *Ann. d'ocul.* 184:714-728, Aug., 1951.

The patients all had general tuberculosis and subacute chronic infections of the cornea, sclera and uveal tract. They received general and local treatment and were hospitalized for 6 to 18 months in Digne, near the Swiss Alps. The elevation is approximately 2,000 feet and the climate is moderate and dry. The authors believe that these patients progressed more favorably than if they had been treated in their native cities.

Chas. A. Bahn.

Sommerville-Large, L. B. **Clinical value of rutin in ophthalmology.** *Tr. Ophth. Soc. U. Kingdom* 69:615-617, 1949.

Rutin is isolated from the flowering leaves of immature buckwheat and is composed of two glucosides, hesperidin and eriodictyol. It has a specific action on the capillaries which is definitely increased by vitamin C. Capillary fragility is easily demonstrated by the fragility test of Wright and Lilienfeld which uses a 5 cm.-circle instead of one 2.5 cm. Treatment with rutin and vitamin C is given in the form of two 60 mg. tablets three times a day combined with 200 mg. of ascorbic acid and should be continued for life.

Beulah Cushman.

6

OCULAR MOTILITY

Brown, G. L. **Sympathetic innervation of the extrinsic ocular muscles.** *J. Physiol.* 112:211-214, Jan. 30, 1951.

Bennati and Isola have claimed that

stimulation of the cervical sympathetic causes contraction of the superior oblique muscle in the cat and dog. Repetition of their experiments under more strictly controlled conditions demonstrated that this finding was really due to contraction of other smooth muscle tissue in the orbit and disappeared when the superior oblique was freed from its relation to other orbital tissues such as the nictitating membrane.

James E. Lebensohn.

Cooper S., Daniel P. M., and Whitteridge, D. **Afferent impulses in the oculomotor nerve from the extrinsic eye muscles.** *J. Physiol.* 113:463-474, May 28, 1951.

The eyes of goats and sheep were studied as their eye muscles are rich in muscle spindles, and are essentially similar in type and distribution to those found in man. The nerve to the inferior oblique muscle was subdivided until the impulses recorded indicated single nerve fibers as characterized by a regular rhythmic series of action potentials of constant height. The rate of the resting discharge varied from 10 to 100 impulses per second. A stretch of the muscle produced a rapid acceleration of the impulses which diminished as soon as the tension was released. The sensitivity of the eye muscle spindles to both increased and decreased tension of the muscle is such as to be capable of detecting movements of less than 1.5°. As the macula in man subtends an angle of 1°, proprioceptive sensitivity is apparently great enough to play a part in the control of eye movements.

James E. Lebensohn.

Cridland, Nigel. **The relation between accommodation and nonfusional convergence.** *Tr. Ophth. Soc. U. Kingdom* 69:567-574, 1949.

The amount of convergence which is produced reflexly by accommodation for any distance is directly proportional to the accommodation in use; the reflex con-

vergence is superimposed upon the basic heterophoria. Beulah Cushman.

Kiloh, L. G., and Nevin, S. **Progressive dystrophy of the external ocular muscles (ocular myopathy)** *Brain* 74:115-143, 1951.

Affection of the eyes in the well known types of progressive muscular dystrophy is extremely uncommon. The most common findings are ptosis and impaired ocular movements. Where the levators of the upper lids or an external ophthalmoplegia were the only myopathies in the entire body, the question arose as to whether they should be classified as a separate clinical group called "ocular myopathy" or as atypical cases of muscular dystrophy. The authors suggest that they be grouped under the name "ocular myopathy." Histological studies of the involved muscles show that the pathological changes are no different from those found in progressive muscular dystrophy. The cases of progressive "nuclear" ophthalmoplegia reported in the literature are considered by the authors to be a part of the "ocular myopathy" group and not a separate entity since proof is lacking that they result from a systematized degeneration of the oculomotor nuclei. (10 figures, references) Francis M. Crage.

Lyle, T. K., and Cross, A. G. **Diagnosis and management of paralysis of the extrinsic ocular muscles.** *Brit. J. Ophthalm.* 35: 511-548, Sept., 1951.

The opinion still persists among many ophthalmologists that little can be done for cases of paralytic strabismus. This study of 219 cases of palsy, however, indicates that the majority of patients with this condition can be very much helped. The author describes in detail the causes and types of defects, the methods of study and the choice of operative procedure. The investigation of each case must be thorough and complete and must include a study of the development of the

diplopia, loss of binocular vision, defective movements and of head tilting as well as measurement of the deviation of the visual axes, limitation of movement, diplopia and angle of deviation in cardinal position, and a study of sensory and motor adaptation to the defect. The value of the Hess screen before and after surgery is particularly emphasized. It is important to distinguish between congenital and acquired paresis; in the former the treatment is invariably operative while in the latter it varies according to the cause. In no case of acquired palsy due to head injury should surgery be done earlier than four months after injury. Tables are presented showing and describing the choices of surgical procedures for each of the extrinsic muscles and the measurements before and after surgery in each case operated upon. Morris Kaplan.

Yoxall, D. E. **Treatment of abnormal retinal correspondence.** *Tr. Ophthalm. Soc. U. Kingdom* 69:559-566, 1949.

Each patient should be treated individually; the vision of both eyes should be made as equal as possible by occlusion, after which the patient may go for operation. Treatment before surgery to try to establish fusion takes too long and has a bad psychologic effect. Postoperative treatment with parallel eyes is begun on the twelfth day, if the operation has been successful. Some children may be orthophoric and never need treatment.

Beulah Cushman.

7

CONJUNCTIVA, CORNEA, SCLERA

Bartlett, R. E., and Mumma, C. S. **Pterygia. Etiologic theories, methods of treatment, and results.** *California Med.* 74: 263-266, April, 1951.

The literature on pterygia is reviewed. In the large number of patients in this

summary it was noted that Mexicans appeared to be particularly susceptible to the disease, and that long-continued exposure to the sun seemed to be an etiologic factor. Dust and other irritants were of less importance. A careful review of the records showed no correlation with other diseases. It is best to consider the pterygium both a conjunctival and a corneal disease.

The authors have had good results with a modified Desmarre's operation combined with a superficial corneal peeling. Healing has been rapid, the mucous membrane is not buried, and there is less postoperative vascularization. Previously unexposed conjunctiva is used to cover the area from which the pterygium was removed. The procedure is clearly described and illustrated.

Orwyn H. Ellis.

Capri, A., and Alagna, G. **The action of leucotaxine on the cornea.** Arch. di ottal. 55:7-22, Jan.-Feb., 1951.

In inflammatory foci, especially in exudates, toxic substances occur which, when injected locally, are capable of provoking the classical vascular and tissue reactions of inflammation. They derive from degenerated cellular proteins. The H substance is such an agent. Recently, Menkin has isolated a thermostable substance which, if injected subcutaneously, produces an increased capillary permeability and shows chemotaxis on leucocytes. The substance has been named leucotaxine. Minute quantities of leucotaxine were inoculated into one cornea of healthy rabbits, the other cornea was treated similarly with histamine (1:1,000 and 1:10,000) and blood serum. The vascular phenomena were observed in the skin and there was a pronounced epithelial hyperplasia and a tissue reaction. Histamine did not produce such a hyperplasia.

John J. Stern.

Clark, G., and Locatcher-Khorazo, D. **Corneal ulcer produced by aerobacter aerogenes.** A.M.A. Arch. Ophth. 45:165-167, Feb., 1951.

A corneal ulcer developed after an operation for ptosis. A gelatinous hypopyon was present. *Aerobacter aerogenes* was isolated from the corneal ulcer and was also found in the nose, throat, stool and urine of the patient. Treatment with penicillin and aureomycin was ineffective; streptomycin was given by subconjunctival injection and rapid improvement resulted. The organism was nonpathogenic for guinea pigs but produced a fatal infection in mice. One strain induced exudative iritis when injected into the anterior chamber of a rabbit. John C. Long.

Ito, Y., Ito, T., and Sasaki, Y. **An electron-microscopic study of the infective agent of trachoma.** Brit. J. Ophth. 35:553-559, Sept., 1951.

The exact nature and structure of the causative agent in trachoma is not known and except for the discovery of the Halberstaedter-Prowazek bodies no infective agent that is constantly associated with the disease has been found; some workers believe that these bodies are a reaction rather than a causative agent. The authors describe the isolation of a body labeled Z., which is present in infected tissue, not present in normal tissue and which was used to infect human volunteers with clinical trachomas. They show photographs taken with the electron-microscope of these Z bodies. Tissue scrapings and washings were taken in all stages of clinical trachomas, centrifuged and filtered and studied by electron-micrographs. The bodies were round or oblong, measured from 20 to 300 mu and occurred singly, each with a surrounding envelope; they seemed to undergo a definite fission type of mitosis. Five human volunteers were infected by direct

inoculation into the conjunctival sac: four developed clinical trachoma and the Z bodies were isolated from their conjunctivas. (4 figures) Morris Kaplan.

Kolinski, Kasimierz. **Ariboflavinosis in eye disease.** *Klinika Oczna* 20:319-327, 1950.

The author discusses the presence of riboflavin in the retina, the lens and the cornea and reviews the literature on the treatment of vascularization of the cornea with riboflavin. He discusses his own experience and describes three cases which improved by treatment with riboflavin. Corneal vascularization similar to that produced experimentally was improved by prolonged medication with riboflavin, as was that which resembled keratitis rosacea. Sylvan Brandon.

Malbrán, J. L., and Manzitti, E. **Scleromalacia and conditions which it resembles.** *Ann. d'ocul.* 184:679-695, Aug., 1951.

The differential diagnosis of scleromalacia is reviewed in detail. Nodular necrotizing scleritis occurs in persons past 50, generally those with rheumatic arthritis. One or more slowly progressive inflammatory nodules appear in the sclera and undergo necrosis. In perforating scleromalacia, the same age group and those with rheumatism are predisposed, but the scleral involvement is usually bilateral and noninflammatory. Paralimbic scleromalacia occurs in the 20 to 30 year group, has no relation to arthritis and is characterized by a single, noninflammatory, slowly progressive lesion near the limbus. In hyalin senile scleral plaques, bilateral multiple gray depressions develop which seldom perforate. Scleromalacia with porphyria is part of a general syndrome. The case histories of two brothers are reported in detail. In the first, that of a man, 48 years old, sym-

metrical oral depressions 3 by 4 mm. with almost overhanging margins were present in the right nasal and temporal sclera located approximately midway between the canthi and the limbus. They had progressed slowly during 15 years, with slight intermittent inflammatory attacks. Otherwise both eyes were practically normal. There was porphyria and marked skin atrophy, especially of the face with partial loss of the eyebrows. In the younger brother the clinical picture was essentially the same.

Chas. A. Bahn.

Maxwell, E. M. **A case of bilateral lymphomata of the conjunctiva.** *Tr. Ophth. Soc. U. Kingdom* 69:619-620, 1949.

A woman, 76 years of age, in 1937, had masses protruding from beneath each upper lid. Biopsy revealed a lymphoma or lympho-sarcoma. X-ray treatments were given and the tumors excised. Six months later there was no sign of recurrence but in 1941 the right cheek became swollen and general weakness developed. She died six months later from "general debility."

The author states that lymphomata will eventually invade neighboring structures. They should be destroyed in the early stages preferably by X-ray radiation.

Beulah Cushman.

McNicholas, P. J. **Primary tuberculous complex in the conjunctiva.** *Irish J. M. Sc.* 6:386-387, Aug., 1951.

The author reports a case of primary tuberculous complex in the palpebral conjunctiva which was initiated by trauma. It occurred in an 8-year-old girl two of whose aunts had active tuberculosis.

Irwin E. Gaynon.

Poleff, L. **First therapeutic trials with a trachomatous virus vaccine.** *Arch. d'opht.* 11:340-357, 1951.

Poleff claims success in protecting indi-

viduals against trachoma by retrotarsal injection of a vaccine composed of attenuated virus. Attenuation was said to be obtained by culture in vitro or by transplantation of the virus to the lip. The vaccine prepared from labial mucous membrane was used for subconjunctival or retrotarsal injection, and also as a collyrium. Favorable results are claimed in 18 cases of severe trachoma, particularly for the corneal complications. The conjunctival changes also had undergone regression.

Phillips Thygeson.

deRoethth, Andrew, Jr. **Glycolytic activity of the cornea.** A.M.A. Arch. Ophth. 45:139-148, Feb., 1951.

The intact corneal epithelium was demonstrated, by the Warburg method, to have a considerable anaerobic, but no aerobic glycolysis, whereas the injured corneal epithelium showed a pronounced aerobic glycolysis, which is characteristic of a metabolically active tissue. In the corneal stroma the rate of anaerobic acid production was the same as that of the aerobic, which is typical of metabolically inactive tissues. An increase in the pH of the suspension medium was paralleled by an increase in the glycolytic activity of the cornea.

John C. Long.

Sarkies, J. W. R. **Aureomycin in trachoma.** Brit. J. Ophth. 35:549-552, Sept., 1951.

Aureomycin was given to 62 consecutive patients with trachoma complicated by secondary infection; 31 patients were treated with aureomycin ointment six times daily, and 31 were given sulphadiazine ointment once daily. Progress was watched with particular reference to retrogression of pannus. Symptomatic relief was noted in all but was more marked and more rapid in those treated with aureomycin and there was reduction of the number and size of the follicles. There

was no appreciable change in the pannus in either series and the author concluded that improvement was due to control of the secondary infection rather than to cure of the trachoma. Morris Kaplan.

Velicky, J., and Vrabec, F. **Congenital cornea plana.** Ann. d'ocul. 184:707-713, Aug., 1951.

In a 16-year-old boy bilateral corneal flattening and two concentric homogeneous opacities were observed on the posterior surface of the right cornea. Prolonged contact of the cornea with the iris during fetal life was considered to be the cause.

Chas. A. Bahn.

Wilde, N. J. **Dacryocystorhinostomy. A case report, using polyethylene tubing.** Plast. and Reconstruct. Surg. 8:234-236, Sept., 1951.

A section of polyethylene tubing 3 mm. in diameter was used to connect the lower end of the lacrimal sac with the nasal cavity in a 16-year-old girl who had had an injury of the face five years previously. All sutures and the tubing were removed six days later. The patient was observed for only one month postoperatively.

Alston Callahan.

8

UVEA, SYMPATHETIC DISEASE, AQUEOUS

Hogan, M. J. **Diseases of the uveal tract.** A.M.A. Arch. Ophth. 45:334-356, March, 1951.

A review of the available literature from July, 1949, to October, 1950, is presented under these headings: inflammations, traumatic and circulatory diseases, congenital anomalies, and neoplasms. (3 pages of references)

E. J. Swets.

Ingalls, R. G. **Bilateral uveitis and keratitis accompanying periarteritis nodosa.**

Tr. Am. Acad. Ophth. pp. 630-631, July-Aug., 1951.

A 66-year-old woman with periarteritis nodosa developed a severe bilateral uveitis and keratitis. Her health had been good until ten days after smallpox vaccination. Swelling and pain began in the extremities and a few months later the right eye became red and irritable with blurred vision but without refractive error. During the third month of illness, severe right retrobulbar pain and numbness of the supraorbital region occurred, and persisted for several months with further visual loss, terminating in blindness and enucleation 18 months after the initial attack. A similar but less severe progressive inflammation of the left eye with greatly reduced vision began six months after the onset in the right eye. A diagnosis of iridocyclitis and sclerosing keratitis was made. Biopsy of a subcutaneous node showed a lipoma and roentgenograms of the bones showed changes similar to those in Boeck's sarcoid. Microscopic examination of the right eye showed endogenous uveitis and keratitis, with marked granulomatous and pigment changes in the iris and ciliary body. About two years after the onset of symptoms the patient died. At autopsy periarteritis nodosa with generalized arteritis and fibrinous degeneration, and acute leukocytosis of the vessel walls was found. Sections from the spleen, pancreas, fallopian tube and kidneys showed marked degenerative change in all layers of the vessel walls.

Claude L. LaRue.

Kapuscinski, W. J. **Defense mechanism in uveitis.** *Klinika Oczna* 20:297-303, 1950.

Typhoid vaccine used parenterally, increases the number of cells of reticulo-endothelial origin in the aqueous. It is most pronounced in acute iridocyclitis. The author devised a formula for the graphic presentation of the process of in-

flammation. The sum of the reticulo-endothelial cells and monocytes divided by the number of lymphocytes and multiplied by the number of leucocytes gives a number which increases proportionally to the improvement in the local inflammation. In chronic iridocyclitis there is no change in the relation of the cells. The author considers that these investigations show the importance of the reticulo-endothelial system in the defense mechanism in focal infections of the eye.

Sylvan Brandon.

Kapuscinski, W. J., Zebrowski, J., and Wrubel, S. **Permeability of the blood-aqueous barrier in iritis which had been treated with typhoid vaccine.** *Klinika Oczna*, 20:290-296, 1950.

The authors describe their technique in experiments on the permeability of the blood vessels of the eye to fluorescein in cases of iritis in which typhoid vaccine had been used. For control purpose fluorescein was injected intravenously into six healthy individuals before and after injection of the vaccine, and the appearance of fluorescein in the aqueous was determined. Twelve patients with iridocyclitis were treated and in nine the vaccine retarded the appearance of fluorescein, in the other three, which were not typical, there was a slight increase in permeability. In the control cases permeability was increased after use of the vaccine. (18 curves) Sylvan Brandon.

di Luca, G. **Clinical and therapeutic observations on sympathetic ophthalmia with particular reference to roentgen-therapy.** *Boll. d'ocul.* 30:354-384, June, 1951.

During the past 19 years, 27 cases of sympathetic ophthalmia have been studied in the Bologna University Eye Clinic. Twenty-seven case histories are summarized in tables, with location of the injury

to the exciting eye, time elapsed between injury and involvement of the second eye (seven days to 28 years), type of trauma, initial and final visual acuity, duration and type of treatment. Eight cases developed after cataract extraction and one after iridectomy; two had corneal abscesses with uveitis, three iris prolapses, one probable iris incarceration, two anterior uveitis, one cyclitis with ossification of the choroid, and two occurred after evisceration of the exciting eye. Negative histologic findings in the exciting eye do not preclude the diagnosis of sympathetic ophthalmia.

Treatment consisted of salicylates, orally and intravenously, in 16 patients; intravenous hexamethylenetetramin in 13; autohemotherapy in 10; intravenous atophan in 9; nonspecific protein in 6, and large doses of oral sulfonamids in 6. Most of the patients also received five to six X-ray treatments of two milliamperes, 170-180 kilovolt through 0.5 mm. zinc and 2 mm. aluminum filter, 33 centimeters from the eye at five to seven day intervals. Not more than one HED was given within one month; if the disease was very severe, shorter intervals and smaller doses were used. Sometimes, after 30-40 days, X-ray treatment was repeated. More than one-third of all eyes recovered with a visual acuity of 10/10 or more; more than three-fourths of all eyes had final vision of one-tenth or more. According to the experiences of the Bologna clinic roentgentherapy is of great value.

K. W. Ascher.

Weekers, R. **The drainage of the aqueous humor.** *Ann. d'ocul.* 184:696-706, Aug., 1951.

The aqueous humor leaves the globe by two systems; in the first, it passes through the trabeculae at the filtration angle into the aqueous veins, the canal of Schlemm and the venous outlets; in the

second, it passes back into the venous circulation of the iris, ciliary body and choroid much in the same way that internal secretions enter the general venous circulation. The rapid absorption of hyphemas from the iris and the favorable action of cyclodialysis and other glaucoma operations illustrate the importance of the second system. Chas. A. Bahn.

9

GLAUCOMA AND OCULAR TENSION

Alexander, G. F. **Considerations on glaucoma.** *Tr. Ophth. Soc. U. Kingdom* 69:337-342, 1949.

The author emphasizes that the presence of haloes around lights and Bjerrum's scotoma are not necessarily associated with a tendency to glaucoma. Unsuspected retropupillary posterior synchiae lead to glaucoma and are sometimes regarded as primary although they are actually secondary. Iridectomy is recommended in all cases of glaucoma. If it fails to reduce the tension, an operation for continuous depletion of the aqueous should be done as an alternative to trephining.

Beulah Cushman.

Fabian, A. **Dark adaptation in glaucoma.** *Klinika Oczna* 20:56-69, 1950.

Dark adaptation was studied in 20 cases of simple glaucoma and two of acute congestive glaucoma. In 12 cases examination was made before and after treatment. It was found that adaptation is lowered in simple glaucoma and the curve of adaptation is similar to that of retinitis pigmentosa. The increase of adaptation slows down or even stops after 15 to 20 minutes and decreases after 40 to 45 minutes. Adaptation increases after treatment with miotics but never becomes normal. The healthy eye with no clinical symptoms of glaucoma usually has decreased adaptation though less than the diseased

eye. There is correlation between visual acuity, visual field and adaptation but not between ocular tension and adaptation. In some cases, after successful operation on one glaucomatous eye, adaptation deteriorated in the sound fellow eye. Glaucomatous patients do not complain of hemeralopia.

Sylvan Brandon.

François, J., Deweer, J.-P., and Vanden Berghe, J. **Simple chronic glaucoma and dominant heredity.** *Ann. d'ocul.* 184:404-422, May, 1951.

In a series of patients with primary simple glaucoma almost 50 percent had ancestors who had had that disease. In the chromosomal theory, chromosomes are considered as a part of the cell nucleus and genes as parts of chromosomes. In the cytoplasmic theory, genes are considered as parts of both cytoplasm and nucleus with a definitely different composition from the rest of the cell. Genetic abnormalities are closely associated with chemical incompatibilities of the gene with the remainder of the cell. Among the anomalies which were observed in glaucomatous families were myopia and ocular malformations especially those involving the uveal tract, lens, retina and optic nerve. Among the markers of monogenetic involvement are iris color, right and left handedness and ocular fixation. A genealogical tree of 84 members in 7 generations is presented; 11 had chronic simple glaucoma; 7 were women and 4 men; 27 died in youth and 14 could not be located. Other ocular or extraocular anomalies were present in 7 of the patients.

Chas. A. Bahn.

Henderson, Thomas. **Combined quadruple operation for glaucoma.** *Tr. Ophth. Soc. U. Kingdom* 69:529-534, 1949.

A surgical approach in the treatment of glaucoma should consider these principles.

1. Posterior sclerotomy gives immediate but temporary relief from unilateral pressure to the intraocular contents. 2. The corneal punch hole provides a vent which safeguards the intraocular pressure from rising above the tissue pressure of the overlying conjunctival flap. 3. Anterior cyclodialysis reconstitutes a passage for the aqueous into the supra-choroidal space and restores the physiologic equilibrium of the intraocular contents. The primary causal factor responsible for unilateral pressure is counteracted. 4. Iridectomy is of minor importance, but it diminishes the liability of impaction of the iris in the punch hole.

Beulah Cushman.

Miller, S. J. H., and Swanljung, H. **Appearance of fluorescein in the aqueous of glaucomatous eyes.** *Brit. J. Ophth.* 35: 356-365, June, 1951.

This paper presents the results of an investigation on the entry of fluorescein into the anterior chamber of the eyes of patients with glaucoma. The charted curves of time of appearance and concentration showed little difference in distribution or spread of the curves between the two types of glaucoma, or between those taken in the three phases of tension. Most of the curves were within normal limits, and were therefore of no diagnostic value. The factors determining the rate of entry of fluorescein into the eye and the degree of concentration remain unknown. There was no correlation between the height and form of the curve and the ocular tension, sex, age, duration of symptoms, blood pressure, or the extent of the glaucomatous process. Raised fluorescein curves were found after the use of miotics; the extent depended upon the time interval and the strength of the drug used. No significant difference was found in patients tested before and after operation. Fluorescein entered the eye more readily in the presence of active iridocycli-

tis, and this may be of value in the differentiation of secondary glaucoma.

Orwyn H. Ellis.

10

CRYSTALLINE LENS

de Berardinis, E., and de Rosa, L. **A study of cataracta nigra and cataracta brunescens.** Arch. di ottal. 55:146-166, March-April, 1951.

Eighteen lenses with cataracta brunescens and four with cataracta nigra were examined. Fischer's hypothesis that melanoidine is responsible for the pigmentation seems to be correct. Nonhemoglobin iron was present but its importance in cataracta nigra is doubtful. The first step in the reaction of melanogenesis, the oxidation of tyrosine and dopa, could not be demonstrated and melanogenesis cannot be assumed to have occurred in the specimens examined. Spectrophotometric examination of normal lenses, cataractous lenses and lenses with cataracta nigra or brunescens showed no difference in their protein content.

John J. Stern.

Chandler, P. A. **Surgery of the lens in infancy and childhood.** A.M.A. Arch. Ophth. 45:125-138, Feb., 1951.

Disorders of the lens in infancy and childhood requiring surgical treatment include congenital cataract, traumatic cataract, cataract associated with uveitis, congenital dislocation of the lens and microphakia. Indications for operation are discussed, factors concerning the choice of operation are considered and methods are suggested for the avoidance of complications. This highly practical article is filled with important information for the clinician.

John C. Long.

François, J., and Rabaey, M. **In vivo examination of the lens by the phase-contrast microscope.** Brit. J. Ophth. 35: 352-355, June, 1951.

The cells of the lens epithelium were studied and photographed in vivo with the phase-contrast microscope. The cells showed clearly-defined homogenous nuclei with well-demarcated nucleoli. Human cataractous lenses showed two types of cells: one pale and polyhedral, the other dark and star-shaped. The polyhedral cells show a large number of regular granulations in the perinuclear area. These granulations are thought to have a well-defined structure and may be connected with enzymatic reactions. The phase-contrast microscope demonstrates the vacuolization of the cells which progresses to their final disintegration.

Orwyn H. Ellis.

von Sallmann, Ludwig. **Experimental studies on early lens changes after roentgen irradiation.** A.M.A. Arch. Ophth. 45: 149-164, Feb., 1951.

Ophthalmoscopic, histologic and cytochemical studies of the rabbit lens were made after exposure to roentgen radiation. Opacities start at the equator of the lens and progress in the posterior cortex and then in the anterior cortex in a characteristic pattern. Changes of the nuclei in the bow and in the preequatorial zone of the lens epithelium were early observed with swelling and disorganization of the lens fibers after changes in the cell nuclei had advanced. Two weeks after irradiation individual nuclei contained less desoxyribonucleic acid of high polymerization than nuclei in a comparable area of the control lens.

John C. Long.

Stallard, H. B. **A corneo-scleral suture in cataract extraction.** Brit. M.J. 2:88-90, July 14, 1951.

The author describes his modification of the McLean corneo-scleral suture. He believes that it has the advantage of reducing such postoperative complications as iris prolapse, opening of the wound and hyphaema.

Irwin E. Gaynon.

Straub, W. **Persistent hyaloid artery.** *Ophthalmologica* 121:194-200, April, 1951.

The occurrence of unilateral microphthalmos and dislocation of the cataractous lens in a 20-year-old French soldier is attributed to an unusually heavy, persistent hyaloid artery which, by its shrinkage, caused the displacement of the lens. The resultant disturbance in lens development was responsible for the stunted growth of the whole eyeball.

Peter C. Kronfeld.

11

RETINA AND VITREOUS

Adamantiadis, B. **Posterior annular detachment of the vitreous and its relation to detachment of the retina.** *Arch. d'ophth.* 11:457-461, 1951.

Adamantiadis studied 60 patients who complained of sudden veil formation before one eye, with or without photopsia. He examined them for detachment of the vitreous and found 26 cases with the typical posterior annular detachment (ring of Weiss). The ophthalmoscopic picture was that of a membrane which folded and unfolded with the movements of the eye and which in most cases presented a ring form corresponding in size to the papilla. These 26 patients were followed from three to four years, and the histories of four are given in detail. One developed a retinal detachment, the only detachment in the series. Of the 26 cases studied, 12 were low myopes or low hyperopes, 7 had a myopia of less than 4 diopters, and 7 others had a myopia of 6 diopters or above. Of the latter, 4 had serious choroidal alterations. Prognosis in these cases was good with respect to retinal detachment; the condition seems to be a degenerative change secondary to myopia or to premature senescence.

Phillips Thygeson.

Altenberger, Stanislaw. **Changes in the fundus in malignant hypertension.** *Klinika Oczna* 20:224-230, 1950.

Hypertonic retinopathy consists of edema of the disc, edema of the peripapillary retina, pronounced narrowing of arterioles, widening and tortuosity of the veins, sclerosis of the arteries, and hemorrhages and exudates (cotton wool spots). Degenerative changes appear gradually and form white exudates. Malignant hypertension is only one form of hypertensive disease and may be brought on by an outside factor such as infection. After removal of the provoking factor, the malignant phase may subside. Sympathectomy may be useful in cases where the kidneys are impaired, and the prognosis is generally poor. Sylvan Brandon.

Arkin, Wiktor. **Pathogenesis, treatment and prevention of thrombosis of the retinal veins.** *Klinika Oczna* 20:380-384, 1950.

Venous thrombosis may be caused by arteriosclerosis, changes in the blood, phlebitis and the vascular crises that occur in hypertension, heart diseases and debilitating diseases. Formation of the thrombus is due to blood stasis and increased intraocular pressure. Treatment depends on improvement of the retinal circulation and the dilatation of the blood vessels, and retrobulbar injection of atropine, priscolin and nicotinic acid are of value. Diuretin and papaverin may be given internally. Small doses of X ray dilate the blood vessels. Anticoagulants are the most effective form of treatment but must be closely watched. Prognosis is always guarded, and the appearance of glaucoma decreases the chance of a favorable outcome. Sylvan Brandon.

de Berardinis, E. **Modern aspects of the biochemistry of the retina with special consideration of the metabolism of the**

photosensitive substance and the enzymatic systems. Arch. di ottal. 55:167-264, March-April, 1951.

This extensive survey is divided into three parts. The subject is discussed under the following headings: 1. Introduction: the visual pigments; visual purple: a. rhodopsine, b. porphyropsine, c. iodopsine, d. different visual pigments, e. macular pigment. 2. General metabolism of the retina; glycolysis and respiration; modification of the pH of the retina; formation of ammoniac; the phosphorescent components of the retina; acetylcholine and cholesterase in the retina. 3. The enzymatic systems: glycolytic system; transformation products; co-enzymes and activators; toxins of glycolysis; the aerobic metabolism; respiratory quotient and oxidative substrates; flavine, ascorbic acid and glutathion; Pasteur's enzyme and the respiratory enzyme of the retina. Other enzymatic systems: the five nucleoses and the different phosphatases; glycogen and its transformations; nucleoproteins.

The author concludes that, in spite of our vast knowledge of the chemistry and composition of the retina, the biochemical role of the different processes which occur during the visual act is not well understood. (about 300 references)

John J. Stern.

Biró, I. Racemose retinal aneurysm. Ophthalmologica 121:201-207, April, 1951.

In the right eye of a 9-year-old girl (with normal left eye) the region of the disc was covered by a mass of snake-like convolutions of large tortuous vessels. About 2-disc diameters from the center of the mass the retina became visible, but an extreme degree of overvascularity of vascular tortuosity prevailed up to the equator. The vision was 20/40. The case is considered to be a congenital anomaly on the order of a racemose aneurysm.

Peter C. Kronfeld.

Bonamour, Georges. The choice and use of vasodilators in retinal vascular occlusions. Ann. d'ocul. 184:729-735, Aug., 1951.

Acetylcholin has a very transient action and is rapidly neutralized in the body tissues by cholinase into inert cholin. Two mgrs. may be administered intramuscularly three or four times daily. Because of its longer action, the manganochloride is the form most widely used. Priscol (benzyl iminazoline) is a more active synthetic sympatholytic, and may be administered retrobulbarly or intravenously. Its action varies widely. Nicotinic acid is most frequently employed as sodium nicotinate, is usually given by retrobulbar injection, and has the most uniform action of all the vasodilators. Dilvasene is a synthetic; its action resembles that of acetylcholin but is of longer duration. It may be administered orally, retrobulbarly or subcutaneously.

In arterial occlusions the primary lesion is most often spastic and vasodilators should be employed during the first stage as they are usually ineffective later. Vasodilators should be used with great caution in advanced atherosclerosis or other degenerative diseases. In primary venous lesions vasodilators should be employed in small doses for a longer time.

Chas. A. Bahn.

Capolongo, Giuseppe. Description of a case of central serous chorioretinitis with a partial coloboma of the optic disc. Arch. di ottal. 55:85-98, Jan.-Feb., 1951.

A case of central serous chorioretinitis is described which failed to respond to intensive vitamin therapy (A,D,C) and vasodilatation but improved under streptomycin and PAS. A congenital anomaly (partial coloboma of the disc) was present, and the author believes that the combination of this condition with the acquired chorioretinitis is not accidental

but the result of a common underlying cause.

John J. Stern.

Colenbrander, M. C. **Experiments on retinitis pigmentosa.** *Ophthalmologica* 121:208-211, April, 1951.

The visual capacities of six patients with retinitis pigmentosa were followed closely with and without treatment. Training alone, that is greater familiarity with the test on reexaminations, improved the results of adaptometry in several cases. Further improvement followed a placebo taken by mouth. Of the various other forms of treatment only prisolol gave distinct results. The author says in conclusions: "Perhaps all our care to determine beforehand the influence of training and suggestion was in vain and perhaps the suggestion which radiated from us in prescribing a drug in which we ourselves had faith, was after all much more efficient than sugar and the hyperemia (due to prisolol)."

Peter C. Kronfeld.

Dancis, J., Lewis, J. M., and Guy, L. P. **Retrolental fibroplasia.** *New England J. Med.* 245:402-406, Sept. 13, 1951.

It has been thought that vitamin A given to premature infants, in large quantity, may be a factor in producing this disease. Water-miscible multivitamin A preparations were substituted for vitamin D while the care of premature infants otherwise remained unchanged. Later vitamin D alone was resumed in an effort to evaluate the relative effect of these two vitamin preparations. All infants reported were examined at six months or older, 98 percent under mydriatics by ophthalmologists. Diagnosis of retrolental fibroplasia was based upon the presence of a retrolental mass that had developed from changes in the vitreous and retina. The results of this extensive study showed that during the time water-miscible vitamin D

preparation was routinely used the incidence of retrolental fibroplasia was very low. After vitamin A was substituted for vitamin D the incidence of the disease remained unchanged for about 14 months. This makes it very unlikely that vitamin A is a factor in the production of retrolental fibroplasia.

C. L. LaRue.

Franceschetti, A., and Chomé-Bercioux, N. **Degeneratio punctata albescens.** *Ophthalmologica* 121:185-193, April, 1951.

The principal point about this case is the non-progressiveness of the condition for a period of at least 49 years. The fundus picture and the adaptometric findings were typical. The patient's sister had the same affection.

Peter C. Kronfeld.

Greenfield, J. G. **The retina in cerebrospinal lipidoses.** *Proc. Roy. Soc. Med.* 44: 686-689, Aug., 1951.

In three cases in which the retina was studied the first (a typical case of Waren Tay-Sachs disease) occurred in an 18-month-old girl, the second in a 4-year-old boy, and the third in a 28-year-old man. The new periodic-acid-fuchsin (PAS) stain technique was used with celloidin sections. In the first case the changes found were similar to others of the Tay-Sachs group but there was more definite evidence of degeneration and disappearance of nerve cells near the fovea. The PAS stained the material and the ganglion cells and phagocytic cells in a differential manner. In the second case the disappearance of the outer nuclear layer along with the rods and cones in the foveal region was similar to previously reported changes. In case three, the author found changes very similar to those in case one, but they were much less severe. These changes might have passed unnoticed without the PAS technique, but this stain showed the fuchsinophil granules in

the nerve cells as well as in the large phagocytic cells. (6 figures, references)

Bennett W. Muir.

Marconcini, E. **Two cases of retinal glioma.** Arch. di ottal. 55:341-354, May-June, 1951.

Two cases of glioma of the retina in infants are described. The literature on the histogenesis is reviewed and histological studies presented which lead the author to confirm the opinion that the tumor should be called retinoblastoma in view of the fact that it develops from embryonal immature cells.

John J. Stern.

Morgan, O. G. **Some cases of fat embolism of the retina.** Tr. Ophth. Soc. U. Kingdom 69:441-445, 1949.

Patients with slight symptoms probably escape undiagnosed. Wilson and Salisbury reported that fat embolism occurred in 0.8 percent of 1,000 consecutive battle casualties. The normal fat content of the plasma is about two percent, and it may be as high as 20 percent in diabetes without producing symptoms. In the body the fat is contained within cell membranes in large globules; there must be rupture of the cell membrane and tearing of local blood vessels or lymphatics if the fat is to get into the blood stream.

Much manipulation of bony fragments may allow fat to enter the venous system. The signs of fat embolism usually develop within 24 hours after the injury. Pulmonary and cerebral symptoms last for several weeks before the condition subsides. In fatal cases there is confusion, followed by delirium with convulsions, paralysis of groups of muscles, coma, pupillary changes, Cheyne-Stokes respiration and a gradually falling blood pressure.

Petechiae occur in the palpebral con-

junctiva, in the skin at the root of the neck and upper part of the chest, and fat may be found in the sputum and urine. In 13 patients reported by McArdle retinal changes were seen in 10. The author's four patients had, respectively, a fracture of the femur, a radical breast operation, a comminuted simple fracture of the tibia, and a malignant tumor in the region of the kidney which was removed with considerable manipulation.

These findings emphasize the importance of careful examination of the fundi in all patients with pulmonary symptoms after operations and manipulations, particularly those involving the long bones.

Beulah Cushman.

Pruszczyński, Aleksander. **Pathologic changes in the fundus of the eye in arterial hypertension.** Klinika Oczna 20:207-215, 1950.

Changes in the fundus of the eye in hypertension depend to a great extent on the duration of the disease and this determines its mildness or malignancy. The degree of intensity of the retinal lesions is influenced by the extent of the changes in the retinal blood vessels. Spasm of the arterioles is the first step in hypertension and results in a more or less marked ischemia. In the early stage a careful examiner may infer some changes; in advanced conditions inflammatory edema of the retina and the disc can be seen and exudates, hemorrhages and areas of degeneration are present. In the early cases if a sclerotic artery presses on a vein, edema of the retina, erythrodiapedesis and hemorrhagic infarcts may appear. In the far advanced cases there are pigmentary changes of the retina and the choroid, followed by atrophy and scars of the retina.

Sylvan Brandon.

Santoni, Armando. **Behavior of eyes with detached retina in the water drink-**

ing test. *Ann. di ottal. e clin. ocul.* 77:323-340, Aug., 1951.

In this test as applied to glaucoma the patient rapidly drinks a liter of water on an empty stomach, and in patients with the vasomotor instability typical of glaucoma the tension should rise shortly thereafter. Santoni applied this same test in a series of nonglaucomatous patients with detached retina and found an increase in tension in the affected eye of 12 out of 15 patients. The rise was independent of the pre-existing tension, of the extent, nature, and duration of the detachment, and of the nature and extent of the breaks in the retina. Santoni believes that an altered permeability of the capillaries is the result and not the cause of the detachment, since the tension did not rise significantly in the sound eyes of his subjects nor in the affected eyes after the retina had been successfully replaced. It is probable that at first the increased permeability allows only the passage of water and electrolytes; the passage of more complex substances at a later stage may account for the familiar changes occurring in the composition of the subretinal fluid and in the transparency of the lens. (References)

Harry K. Messenger.

Scuderi, G., and Siliato, G. **Stargardt's familial macular degeneration.** *Arch. di ottal.* 55:99-126, Jan.-Feb., 1951.

Four cases belonging to two families are described. There was a marked ophthalmoscopic difference between the members of the same family and also between the two eyes of the same patient. Other findings were a congenital hypacusia in one patient and ovalocytosis of the red corpuscles in two others. The pathogenetic mechanism is considered to be an embryogenetic disturbance of the hypothalamic-hypophyseal region.

John J. Stern.

Sobanski, Janusz. **Arterial hypertension and the eye.** *Klinika Oczna* 20:184-202, 1950.

The author discusses the problems of essential arterial hypertension. The material is based on examinations of 60 ambulatory patients and 46 patients hospitalized because of hypertension, and also on the studies which he has been conducting since 1934 and published in 23 papers.

The author suggests the following classification of the degrees of hypertensive changes in the fundus of the eye.

1. Functional changes in the blood vessels of the retina.

2. Organic changes in the blood vessels of the retina with or without symptoms of thrombosis in a branch of the central retinal vein causing possible changes in the retina and the intraocular part of the optic nerve.

3. Organic changes of the retina and the intraocular part of the optic nerve caused directly by arterial hypertension.

4. Late changes of arterial hypertension in the retina and the optic nerve which appear in hypertensives who survive long enough.

The purpose of this classification is to correlate clinical symptoms with pathologic changes in the eye. The author's studies show that the blood pressure of the central retinal artery in all forms of hypertension increases proportionately to the blood pressure of the brachial artery remaining $\frac{1}{3}$ lower than the latter. The diastolic pressure in the central retinal vein is not affected by hypertension; it is affected by the intracranial pressure. The systolic pressure in the vein is not affected by the pressure of the intracranial fluid but increases in hypertension reaching levels above the diastolic pressure of the artery. Organic changes in the tissues supplied by the retinal blood vessels are due to the anoxemia of a certain duration.

Similar organic changes appearing without hypertension are due to conditions impairing circulation and causing anoxemia.

Sylvan Brandon.

Sysi, R. **Retinal micro-aneurysms in connection with generalized diseases causing retinopathy.** *Brit. J. Ophth.* 35:560-567, Sept., 1951.

Retinal micro-aneurysms are frequently seen in diabetes, arteriosclerosis, nephritis and nephrosclerosis and are at times so similar in form that the diseases are indistinguishable ophthalmoscopically. These aneurysms have been studied in great detail in diabetes but not in the other diseases. In this study the retinas were removed from 143 pairs of eyes from patients with arteriosclerosis, nephrosclerosis and diabetes after necropsy. Aneurysms were found more frequently in younger patients with arteriosclerosis than in older and were more common in older nephrosclerotic patients and about evenly distributed as to age in nephritic patients. Histologic studies showed that the retinal changes often preceded changes in the general vessels. It is suggested that the aneurysms are not a result of hypertension, arterial or renal disease or hyperglycemia but a result of a disorder in the central regulation of circulation which is common to all these diseases. This does not infer that these diseases are manifestations of the same disease but rather that there is some central dysfunction common to all.

Morris Kaplan.

Zubczewski, Adam. **Results of treatment of retinitis pigmentosa with stored blood.** *Klinika Oczna* 20:391-405, 1950.

Blood was stored for 8 days after which daily intramuscular injections of 15 cc. were given for 15 days. A new period of 15 injections followed a 7-day rest. Visual field, visual acuity and color perception

were measured. After maximum improvement was reached a two to three month rest period was followed by reexamination of the patient.

Sylvan Brandon.

12

OPTIC NERVE AND CHIASM

Capolongo, Giuseppe. **Optic neuritis in measles.** *Arch. di ottal.* 55:71-84, Jan.-Feb., 1951.

Two patients with optic neuritis during measles recover completely. This very rare complication is ascribed to a neurotropic tendency of the virus.

John J. Stern.

Hughes, Brodie. **The diagnosis of optic atrophy.** *Tr. Ophth. Soc. U. Kingdom* 69:411-423, 1949.

The diagnosis of optic atrophy is difficult. The optic nerves may be affected by direct or indirect injury, by pressure or destruction from tumor, by aneurysm or some interference with the blood supply, by inflammatory processes and specific toxins, by degenerative processes and by raised intracranial pressure or there may be a mixture of these processes. Vascular lesions occur from many causes. The anatomy of the vessels determines the nature of the field defect and there is usually an inferior or a superior hemianopsia, which may be due to an indirect injury to the optic nerve such as occurs in anemic and post-hemorrhagic states and in vascular tumors of the nerve. Arteriosclerotic changes may show an irregular border of the hemianopsia. Arteriosclerosis with thrombosis in small vessels is often found to be the cause in older people and is manifest by a progressive loss of the peripheral fields. Pressure from a sclerotic carotid or anterior cerebral artery may explain bizarre central field defects. Arachnoiditis in the region of the nerve and chiasm is sometimes present. Direct injury may cause the nerve to be com-

pletely severed or avulsed. Indirect injury may be due to damage from thrombosis of small nutrient vessels or a diffuse injury to the fibers from torsion or stretching. Incomplete vascular injury usually affects the upper part of the nerve as it is this part that has the closest attachment to the sheath in the canalicular portion, and produces inferior hemianopsia.

One should beware of localizing the site of a tumor by the part of the field affected. If the tumor is intrinsic, peripheral field changes occur usually at an early stage and are the results of nerve-fiber-bundle scotomas breaking through to the periphery. In edema of the nerve head there is enlargement of the blind spot and an enlargement of the pericentral relative scotoma which usually occurs on the nasal side and extends towards the macula. Consecutive atrophy is seen at the periphery of the nerve head and gives rise to a true coastal erosion type of peripheral defect of the field.

Toxic amblyopia is probably a manifestation of many conditions of toxemia or vitamin deficiency. It is probable that most of the ocular changes are the result of the vascular disease.

Tobacco-alcohol amblyopia is a type in which the fundus changes are slight and atrophy is late. The field changes are centrocecal scotomas. Parts of the peripheral field are lost late, and the defect is often limited by the vertical meridian. A lesion of the papillomacular bundle results in an extremely dense pericentral scotoma.

Beulah Cushman.

Wilczek, Marian. **Atrophic excavation of the optic disc.** *Klinika Oczna* 20:279-289, 1950.

Excavation of the optic disc which reaches the margin is usually considered to be due to glaucoma, even if tension is normal. Excavation in old individuals without increased tension has been called

pseudoglaucoma by Goldman. Factors which influence the formation of such excavation may be a change in blood supply, the arterial blood pressure and the resistance of the nerve bundles. The author describes three cases of optic atrophy due to methyl alcohol poisoning where excavation reached the margin and one case in which he was able to exclude glaucoma. He discusses these cases and the mechanism of development of the excavation. (4 figures) Sylvan Brandon.

13

NEURO-OPHTHALMOLOGY

Bamford, Charles. **Ophthalmoscopic findings in cases of lumbo-dorsal sympathectomy for hypertension.** *Tr. Ophth. Soc. U. Kingdom* 69:425-430, 1949.

Twenty-three patients with hypertension who had been operated upon and followed for a period of from six months to three years are described; 14 were women and 10 men, and the ages ranged between 32 and 49 years. There were 5 patients with malignant hypertension and 18 with benign essential hypertension. All had headache, dyspnoea, blurred vision, transient hemiplegia, congestive heart failure and ophthalmoplegia, four had had toxemia of pregnancy and showed marked attenuation of the arterioles. In two others sclerotic changes were also present. Three patients had splanchnicectomy and lumbar sympathectomy with no division of the dorsal sympathetic; the remaining 20 had bilateral lumbo-dorsal sympathectomy from the ninth thoracic to the second lumbar vertebrae. One patient died immediately after operation and is not included in the series. Three patients died after the second stage had been completed, one from uremia six months later, one after twelve months, and one died from a cerebral hemorrhage. All had malignant hypertension. The prognosis of

malignant hypertension is poor without operation and surgery is justified as it may bring improvement in 20 percent.

In essential nonmalignant hypertension the results are much better. In this series the early changes in the fundus were irregularity and attenuation of the peripheral retinal arteries. These changes are reversible. The sclerotic changes in the vessel walls, although irreversible, may be prevented from progressing. In some patients with malignant hypertension edema of the nerve head and retina may disappear. Beulah Cushman.

Correa de Barros, E. **The retinal arterial pressure in obliterations of the cerebral arteries.** *Ophthalmologica* 121:211-216, April, 1951.

In two cases of hemiplegia due to obliteration of one anterior cerebral artery the author found the retinal arterial pressure on the affected side decidedly lower than on the nonaffected. Such a difference was not encountered in obliterations of branches of the anterior cerebral or of any more posterior artery.

Peter C. Kronfeld.

Kwaskowski, A., and Stepień, L., **A case of Foster-Kennedy syndrome.** *Klinika Oczna* 20:274-278, 1950.

A man, 42 years of age, had a tumor at the base of the right frontal lobe with symptoms, before operation, of blindness of the right eye without optic atrophy, and choked disc in the left eye with 6/9 vision. Venous pressure in the right eye was 50/22, in the left 50/40. There was weakness of the left upper extremity and of the left side of the face. The tumor was removed and found to be glioblastoma multiforme. The patient recovered from the operation but eventually there was bilateral optic atrophy with no vision in the right eye and 1.5/60 in the left and a 10 to 15° visual field. The authors con-

clude that the Foster-Kennedy syndrome is suggestive of a tumor at the base of the frontal lobe. The intensity of the symptoms depends on the period of growth of the tumor. Sylvan Brandon.

Love, J. G., Wagener, H. P., and Woltman, H. W. **Tumors of the spinal cord associated with choking of the optic disks.** *A.M.A. Arch. Neurol. and Psychiat.* 66: 171-177, Aug., 1951.

The authors describe three cases of spinal cord tumor at the level of the lower thoracic and upper lumbar vertebrae. There was papilledema of from three to five diopters in all three. In two removal of the spinal tumors was followed by return of visual acuity to normal and near normal, and headache and other pain was relieved. The visual fields were not affected. In one case, the separation of the sutures and the decalcification of the sella had disappeared. The optic edema was considered to be a manifestation of optic neuritis or axial retrobulbar neuritis, probably brought about by internal hydrocephalus. In a third case, cerebellar exploration revealed a leptomenigitis. The spinal cord tumor present was too extensive to remove. Prolonged, marked symptomatic relief of headaches, ocular paralysis, and other symptoms followed exploratory cerebral surgery and X-ray therapy. Francis M. Crage.

di Luca, Giuseppe. **The importance of the visual field in some disturbances of the cerebral blood circulation.** *Riv. oto-neuro-oftal.* 26:30-53, Jan.-Feb., 1951.

Nine patients (one woman) 34 to 76 years of age were affected by endocranial circulatory disturbances. The writer emphasizes the importance of the visual field in the diagnosis of endocranial vascular lesions and in following their progress. In seven patients the circulatory deficiency took place behind the retrogenicu-

late optic paths; in two there was occlusion of the central artery of the retina and functional changes of branches of the Sylvian artery of same side. These changes were revealed by the visual field of the apparently sound eye. Such disturbances of the posterior sections of the brain can be diagnosed almost exclusively by observation of the visual field. (16 figures, references) Melchior Lombardo.

Madonick, M. J. **Ophthalmoplegia internuclearis anterior without a lesion of the posterior longitudinal bundle.** A.M.A. Arch. Neurol. and Psychiat. 66:338-345, Sept., 1951.

In most of the 20 reported cases of ophthalmoplegia internuclearis anterior, there have been brain stem lesions. In five cases no such lesions could be demonstrated and the author adds another case. Internuclear ophthalmoplegias are divided into the posterior and anterior type. In the posterior type the eye cannot be adducted in conjugate lateral gaze without diplopia, and in the anterior group the eye cannot be adducted without diplopia but retains the function of the internal rectus muscle in convergence. Many times paralysis of lateral conjugate gaze with convergence preserved has been observed, and from causes such as tumor and tubercle of the pons and tuberculous meningitis. The case reported in this study is that of a 20-year-old negro who had a probable tumor of the posterior fossa. The pupils were unequal but both reacted to light. Neither eye could be adducted but convergence was intact, and no diplopia or constriction of fields was present. There was bilateral papilledema and hemorrhage in the right fundus. Corneal reflexes were depressed but there was no facial weakness. After extensive neurologic study a suboccipital craniectomy was done. A large cerebellar tuberculoma and a smaller one in the right third frontal convolution

were found but no lesion was present in the posterior longitudinal bundle or elsewhere in the brain stem. The patient died at the the conclusion of the operation and autopsy revealed nodular masses in the adrenal gland and in both lungs, which showed typical tuberculosis. Compression of the brain stem by a tumor of the posterior fossa may interfere with the function of the posterior longitudinal bundles without anatomic changes. The presence of ophthalmoplegia internuclearis anterior is not necessarily a contraindication to surgery. Claude L. LaRue.

Mooney, A. J. **On the diagnosis of certain intracranial vascular lesions.** Tr. Ophth. Soc. U. Kingdom 69:621-646, 1949.

Carotid aneurysms are classified as infraclinoid or cavernous and supraclinoid. The infraclinoid are subdivided into posterior cavernous, which affect the three sensory branches of the trigeminal nerve and some ocular muscles, and middle cavernous which affect the first and second divisions of the trigeminal nerve. If the aneurysm is fistulous, pulsating exophthalmos and conjunctival venous congestion are present. The close relationship of the aneurysm to the optic nerve or the chiasm probably brings about some loss of vision. Decreased vision and trigeminal pain are the chief symptoms of aneurysms arising from the ophthalmic or posterior communicating arteries. A history of subarachnoid hemorrhage is common.

Eighteen cases are reported, 12 of them in women; 13 patients had severe headache in the frontal region of the affected side, all had trigeminal pain and partial or complete third nerve palsy, except three patients with carotid cavernous fistula in whom there was bilateral sixth nerve palsy, intrasellar aneurysm and subchiasmal aneurysm. Angiography is of value in demonstrating the presence of a tumor. Beulah Cushman.

Sapuppo, Concetto. **A sarcoma of the sphenoid fissure.** Riv. oto-neuro-oftal. 26: 1-9, Jan.-Feb., 1951.

A 52-year-old woman had shown a progressive forward exophthalmos for two months accompanied by a deep orbital pain. The eyeball did not recede on pressure. The corrected vision of this eye was 8/10 and the visual field was concentrically contracted about 30°. Crossed diplopia was present. Radioscopic examination confirmed the diagnosis of tumor at the apex of the orbit. A tumor of the lesser wing of the sphenoid was found by a Krönlein operation. Macroscopic and microscopic examination revealed a spindle-cell sarcoma. The operation was followed by metastases into the femur and the liver. (4 figures, references)

Melchior Lombardo.

Skotnicki, H. K. **Mechanism of papilledema.** Klinika Oczna 20:241-273, 1950.

Many theories attempt to elucidate the problem of papilledema by stressing certain aspects. The author presents the experimental work of other investigators, particularly that of Kyrieleis and Sobanski, and discusses their experiments and conclusion. He then describes in detail his experiments on dogs and emphasizes the differences in his technique and that of other investigators. Before presenting his own conclusions he analyses all other theories.

Skotnicki believes that in papilledema there is a breakdown in the relation between the venous and arterial blood pressures and that the vascular system of the eye, particularly its venous components, are the first to react to an experimental increase of intracranial pressure. Experimentally papilledema results from venous stasis due to the direct pressure on the part of the nerve containing the blood vessels or the pressure of the increased cerebrospinal fluid on the same spot.

Only moderate degrees can be produced. He concludes that irrespective of etiology, papilledema is caused by venous stasis when the venous pressure exceeds the critical point in relation to the arterial pressure. When the venous pressure equals the arterial pressure the conditions necessary for the development of papilledema cease to exist. Sylvan Brandon.

14

EYEBALL, ORBIT, SINUSES

Bonamour, G., and Rougier, J. **The etiology of bilateral exophthalmos.** J. de méd. de Lyon 32:585-596, June 20, 1951.

The authors review the etiology of bilateral exophthalmos and state that it is generally easy to recognize the cause of the exophthalmos in malformations of the skull and in acute inflammations such as tenonitis, orbital cellulitis and anterior and posterior thrombophlebitis. The many cases of chronic exophthalmos such as chronic orbital myositis, chronic orbital phlebitis and orbital manifestations of Hodgkins' and Mickulicz's disease are the ones which are difficult to evaluate, as is also the unusual development of bilateral primary or metastatic tumor. The bilateral exophthalmos in endocrine diseases is especially interesting. The difference in the appearance of the eyeballs in Basedow's disease and in malignant edematous exophthalmos is discussed at length, with special reference to clinical implications and deductions. Alice R. Deutsch.

Bonnet, Paul. **The diagnosis of unilateral exophthalmos.** J. de méd. de Lyon 32:561-583, June 20, 1951.

Unilateral exophthalmos is always an important symptom and offers diagnostic problems entirely different from those in bilateral exophthalmos. Exophthalmos is caused by characteristic anatomical lesions which must be accurately inter-

preted if treatment is to be successful. Occasionally it is impossible to recognize the nature of the orbital lesion by clinical means only and explorative surgery is necessary in order to get a specimen for biopsy. In Bonnet's opinion, although biopsy might promote a quick diagnosis, it is dangerous and should not be practiced merely to save time. A benign or malignant orbital tumor can be recognized clinically, and intracranial propagation of a growth may be determined by blood and laboratory studies. In an inflammatory pseudotumor the exploratory orbitotomy often aggravates the exophthalmos by increasing the orbital edema. For these reasons Bonnet is opposed to biopsy.

Alice R. Deutsch.

Delaney, A. J., and Oliver, S. H. **Orbital decompression, transmaxillary approach: report of a case.** U. S. Armed Forces M.J. 2:1079-1084, July, 1951.

A case of acute orbital cellulitis is presented, in which a transmaxillary approach was made through the canine fossa. The roof of the sinus was removed and when the fascia had been incised, the pressure was released.

Irwin E. Gaynon.

Ghinaglia, V. **Exophthalmos from mucocele of the maxillary sinus.** Riv. oto-neuro-oftal. 26:10-29, Jan.-Feb., 1951.

A man, 43 years of age, had noticed for a few months that his left eye was becoming slightly prominent. He also had photophobia and occasional headaches. The vision of this eye was 9/10 and could not be corrected by glasses. There was a central scotoma for colors. X-ray studies showed opacity of the left maxillary, ethmoid and frontal sinuses. The maxillary sinus was filled with pus and its posterior upper section eroded for about 2 cm. The postoperative diagnosis was suppurated mucocele of the left maxillary sinus with ero-

sion of the floor of the orbit. A biopsy of a fragment of mucous membrane showed polypoid proliferation histologically. (2 figures, references)

Melchior Lombardo.

Margotta, G. **A singular case of unilateral recurrent exophthalmos.** Arch. di ottal. 55:271-284, May-June, 1951.

A girl, 15 years of age, had had a unilateral recurrent exophthalmos since early childhood, accompanied by a well defined, mobile tumefaction of the cheek of the same side. Glandular dystrophy and a vascular lability of the type of circumscribed intermittent angiopsathyrosis were also present. Biopsy of the tumor and retrobulbar tissue showed a non-specific inflammation which resembled a pseudoangioma. The swelling of the cheek and exophthalmos progressed slowly without metastases or signs of malignancy. The etiology is assumed to be an embryologic malformation.

John J. Stern.

Okie, M. V., Denec, H. B., and Daley, W. **Estradiol implants in postoperative pituitary exophthalmos.** J. Internat. Coll. Surg. 16:98-100, July, 1951.

Exophthalmos may be due, among other things, to pituitary dysfunction. Thyrotropic hormone from the anterior lobe of the pituitary gland has produced experimental exophthalmos in guinea pigs. Estrogen and androgens suppress gonadotropic function of the anterior pituitary lobe and this has led to their use in attempting to suppress thyrotropic hormone production in treating exophthalmos of pituitary origin. Estrogen therapy in the form of steroid implants was used in the following case of postoperative pituitary exophthalmos. Subtotal gastrectomy with posterior gastrojejunostomy was performed on a 52-year-old man because of a large nonmalignant

gastric ulcer. The postoperative course was at first uneventful but after one week a pronounced exophthalmos occurred. With palliative measures the exophthalmos regressed, and the patient was discharged. Seven weeks later he was readmitted with marked exophthalmos, lid lag and bubble-like lens lesions. Two 25 mg. estradiol pellets were implanted in the subcutaneous tissue of the thigh and dramatic recession of the exophthalmos followed. Increase of eosinophils and urinary output of 17-ketosteroids was thought to mean hypofunction of the adrenal cortex.

Claude L. LaRue.

15

EYELIDS, LACRIMAL APPARATUS

Ashton, N., Choyce, D. P., and Fison, L. G., **Carcinoma of the lacrimal sac.** *Brit. J. Ophth.* 35:366-376, June, 1951.

The authors summarize the literature on tumors of the lacrimal sac and report two new cases. Epithelial neoplasms are more common than non-epithelial. These tumors are pathologically similar to those which arise from the respiratory epithelium of the nasal cavities. It is probable that all primary malignant tumors of the lacrimal sac arise in the same way and that the different histologic descriptions are examples of different developmental stages of solid cylindrical carcinoma. They possess malignant potentialities of varying degrees with a strong tendency to recurrence. Papillomata of the lacrimal sac epithelium are probably malignant from the beginning. (2 tables, 7 photomicrographs) Orwyn H. Ellis.

Brand, Imre. **Hemostasis during dacryocystorhinostomy.** *Ophthalmologica* 121: 217-220, April, 1951.

The author recommends the topical application of prinine (by instillation into

the wound) to control bleeding during the dacryocystorhinostomy.

Peter C. Kronfeld.

Castarnes, S. **Blepharoplasty for herniated intraorbital fat.** *Plast. and Reconstruct. Surg.* 8:46-58, July, 1951.

Blepharochalasis is a rare condition limited to upper lids in which the thin skin lies in many small wrinkles, like crumpled tissue paper, and hangs down like a pouch because of the extreme relaxation and looseness of its attachments. It is said to be the result of recurrent painless edema such as the angioneurotic type which stretches the skin, depriving it of its elasticity. It is most frequently seen in young and middle-aged women. In ptosis adiposa the fascial bands connecting the skin with the palpebral musculature and the orbital rim are relaxed. The term is a misnomer, since there is no true deposition of fat in the skin of the lid.

Herniation of intraorbital fat is the result of congenital extension of the orbital fat through a defect in the fascia and orbicularis muscle, and may be due to a familial tendency to an abnormal regional deposition of fat. There is loss of firmness and elasticity of the skin and of the fascia tarso-orbitalis that lies beneath. Anteriorly, there are three definite and separate pockets of encapsulated fat in the lower eyelid and two similar ones in the upper eyelid. Each one of these lobular groups of fat is well encapsulated, distinct and independent one from the other. The inferior oblique and the superior oblique muscles further divide these groups of fat in the upper and lower eyelids. Each accumulation of fat is well encapsulated by the thin but firm connective tissue capsule and this capsule has to be cut in order to produce protrusion of the fat for its removal; failure to open each will result in incomplete removal.

At operation the orbicularis fibers are separated by blunt dissection, but none are excised. The removal of the herniated fat should be started first through a stab opening in the lateral aspect of the lower lid. The other pockets are then reached by incising the capsule with scissors, and the fat removed through the longer incision line and skin resection of the lids. All excessive fat is removed, which is usually that portion presented above the glistening white periosteum of the orbital margins. The tarso-orbital fascia should be cut along the separated fibers of the orbicularis muscle; it is difficult and unnecessary to suture together the margins of the ruptured fascia after the extirpation of fat. (12 figures) Alston Callahan.

Gordon, G. **Observations upon the movements of the eyelids.** *Brit. J. Ophthalm.* 35:339-351, June, 1951.

Three groups of functional activity of the orbicularis muscle were identified in man by electromyography. They were divided into those responding in blinking and in the corneal reflex; those responding both in blinking and in sustained activity; and those responding only in sustained activity. Considerable anatomical overlap was found. Those of the first group lie mainly in the pretarsal regions, those of the second in the preseptal, while those of the third group extend from the preseptal to the orbital regions. In blinking the units of the first group discharged short bursts of impulses at very high impulse frequencies. These could be voluntarily initiated, but not graded nor sustained. Units of low threshold in the second and third groups take part in voluntary and involuntary narrowing of the lids, and in tonic contractions. Units of the higher voluntary threshold take part in screwing up the eye and to a small extent in smiling.

The activity of the levator palpebrae

superioris was studied in the anesthetized baboon. A drop in frequency occurred 35 to 85 msec. before the blink in about half the records. This preliminary partial relaxation of an antagonist is not a recognized feature of muscular contractions, but it may allow the orbicularis to contract from the start against a reduced resistance, and this would shorten the time during which vision is disturbed.

Orwyn H. Ellis.

Huck, H. **The fluorescein test for patency of the lacrimal passages.** *Ophthalmologica* 121:110-113, Feb.-March, 1951.

The principle of the test is the demonstration of passage into the nose of fluorescein instilled in the conjunctival sac. A cotton roll is placed under the inferior turbinate and a tiny amount of fluorescein introduced into the cul-de-sac. The patient is asked to blink and move his eyes normally without concentrating on any particular object. Five minutes later the cotton packing is removed from the nose, and examined. In eyes that contain very few tears it is advisable to add one or two drops of saline to the contents of the conjunctival sac. The addition of one or two drops of 0.1-percent epinephrine facilitates the passage of fluorescein into the nose. With these additions the fluorescein test is a fairly reliable indicator of patency or non-patency of the lacrimal passages.

Peter C. Kronfeld.

Kamel, Sabri. **Partial resection of the upper eyelid and its repair.** *Brit. J. Ophthalm.* 35:377-379, June, 1951.

In a case of excision of more than one-half of the upper lid for adenocarcinoma of a Meibomian gland the procedure used for repair is presented in detail. The unaffected tissue and a large sliding flap from the temporal area were utilized in making the repair. (3 figures)

Orwyn H. Ellis.

Kapuscinski, W. **Conservative treatment of the lacrimal passage.** *Klinika Oczna* 20:361-366, 1950.

The author discusses the treatment of the lacrimal passages. Conservative treatment is suggested before extensive probing is done. Swelling and secretion may close the lacrimal duct and the treatment of the inflammation may open the passage. Cases of lacrimal mucocele should be treated by dacryocystorhinostomy.

Sylvan Brandon.

Pavišić, Zvonimir. **The repair of lid colobomas due to trachoma.** *Ophthalmologica* 121:225-227, April, 1951.

Coloboma-like crescent-shaped defects of the upper lid border occur in severe cicatrifying trachomas, with or without the aid of unsuccessful entropion operations. For the repair of such colobomas the author recommends an operation consisting 1. of an intramarginal incision in the area of the coloboma, 2. freeing of the conjunctiva, and 3. repair of the tarsus and skin defect by a free transplant of ear cartilage with the overlying skin.

Peter C. Kronfeld.

Rappaport, O. C. **The surgical treatment of cicatricial entropion due to trachoma.** *Ophthalmologica* 121:221-224, April, 1951.

On the basis of experiences in the Dutch East Indies the author has slightly modified Ewing's entropion operation (*Tr. Am. Ophth. Soc.* 9:15, 1900).

Peter C. Kronfeld.

Rycroft, B. W. **Surgery of external rhinostomy operations.** *Brit. J. Ophth.* 35:328-338, June, 1951.

When the diagnosis of lacrimal block had been made, careful examinations by a rhinologist and radiologist were done. The operations of dacryoadenectomy and dacryocystectomy were not successful.

Where the sac and canaliculi are intact, dacryocystostomy was preferred. The operation of Dupuy-Dutemps is described in detail: the exposure of the lacrimal fossa, the mobilization of the lacrimal sac, the use of the thin rhinostomy lamp, the opening in the nasal bone, the suturing of the flaps and the postoperative care. Canaliculo-rhinostomy has given poor results. Where the upper canaliculus is obliterated, simple canthocystostomy, or the opening of the lacrimal sac into the conjunctival fornix gives good results. When both the sac and canalicula are absent, a tube made of buccal mucous membrane placed between the conjunctival fornix and the nose has been successful.

Orwyn H. Ellis.

Rycroft, B. W. **Traumatic epiphora.** *Tr. Ophth. Soc. U. Kingdom* 69:507-519, 1949.

Traumatic epiphora is due to late effects of 1. severe third and fourth degree burns; 2. severe soft tissue lacerations; 3. fractures of the middle third of the facial bones; 4. failure of tear drainage as a result of surgical operations such as cystorhinostomy or excision of the lacrimal sac; and 5. congenital absence of the lacrimal passages. The author points out that an anatomical success is not necessarily a physiological success as some eyes water even though there is free patency to fluid or air. In the absence of a lacrimal sac canthorhinostomy is recommended.

Beulah Cushman.

Stanworth, A. **Kerato-conjunctivitis sicca.** *Brit. J. Ophth.* 35:317-327, June, 1951.

In the diagnosis of keratoconjunctivitis sicca the clinical signs and symptoms were generally definitive, and the Schirmer test, and staining with rose bengal were merely confirmatory. In severe cases there was marked discomfort, obvious corneal change and the tests were

strongly positive. The disease is thought to be due to the combination of several factors as these patients often have arthritis and dryness of the mouth, associated with recurrent attacks of infection, particularly of the parotid gland. Histological study showed glandular degeneration with lymphoid infiltration and proliferation of connective tissue, and subepithelial edema of the conjunctiva. A more acute and patchy process may occur causing a swelling of the lacrimal glands which may cause a ptosis. The disease process affects both the accessory and main lacrimal glands, and may have a vascular basis, which would account for the conjunctival edema. Diathermy to the canaliculi should not be used until conservative treatment has failed. Its effect is transient, and is probably due to the removal of secondary blockage of the lacrimal ducts by a reflex stimulation of the lacrimal secretion. Orwyn H. Ellis.

Starkiewicz, Witold. **Treatment of dacryocystitis.** *Klinika Oczna* 20:367-379, 1950.

The author is opposed to prolonged probing in treatment of strictures of the nasolacrimal duct. He describes the indications for extirpation of the lacrimal sac and considers dacryocystorhinostomy the operation of choice. Of 39 dacryocystorhinostomies 30 were observed long enough to judge the result. In 7 the opening in the bone closed and 23 had a properly functioning nasolacrimal opening.

Sylvan Brandon.

Summerskill, W. H. **Treatment of chronic dacryocystitis.** *Tr. Ophth. Soc. U. Kingdom* 69:494-505, 1949.

Epiphora is due to an oversecretion of tears and to defective drainage; in the epiphora of dacryocystitis both factors operate. The oversecretion is the result of abnormal nervous stimuli which may

be psychologic, neuropathic or reflex. A congenitally defective bony canal is frequently a factor. Conservative treatment with pressure and irrigation are to be recommended first, followed by surgery for recurrences. The author describes the insertion of a polythene tube, 18 mm. by 2.5 mm., with satisfactory results in some patients. Beulah Cushman.

16

TUMORS

Arjona, J. **Late recurrence of a sarcoma of the choroid.** *Arch. Soc. oftal, hispano-am.* 11:619-627, June 1951.

Thirteen years after the enucleation of an eyeball for a choroidal sarcoma, an orbital recurrence developed. Arjona stresses that a patient cannot be considered cured even after many years, and that the degree of pigmentation of the tumor has no relation to the degree of malignancy. This tumor was black with pigment. Ray K. Daily.

Bonnet, Paul. **Concerning a rare clinical form of orbital tumor. The "ocular" form of orbital tumors.** *Arch. d'ophth.* 11:329-332, 1951.

Bonnet reports the case of a man who in 1946 developed visual phenomena in the left eye consisting of sparks, luminous crescents, and rotating lights when he passed from light to dark, or vice versa. Examination showed a normal fundus and a hyperopia which was corrected by glasses. The phenomena persisted and later pain and lowered visual acuity developed. Ophthalmological consultation at this time confirmed the drop in vision but no fundus lesions were noted. In 1948 a sudden intolerable pain developed in the left eye and a second ophthalmologist noted the presence of a choroiditis for which no cause was uncovered and which penicillin failed to improve. A third

ophthalmologist noted an intense papillitis with exudative detachment of the retina. Eight applications of radiotherapy led to improvement in vision and to reattachment of the retina. In August, 1949, however, another attack of violent pain occurred; at this time a glaucoma with tension of 60 mm. Hg, secondary to a uveitis, was noted, and in spite of treatment led to loss of vision.

When first seen by Bonnet an exophthalmos with a palpable orbital mass was present; this eye had been slightly more prominent than the right even before the onset of visual symptoms in 1946. An orbital exenteration revealed the presence a malignant melanoma which had invaded the optic nerve, but not the interior of the eye. The possibility of a metastasis to the orbit was considered but no primary lesion was uncovered. The ocular symptoms were apparently due to nerve involvement and to deformation of the sclera by the tumor mass. In view of the predominance of the ocular signs over the orbital ones, Bonnet feels that the use of the term "ocular form" of orbital tumor is justified.

Phillips Thygeson.

Cometta, F. **A case of reticulosarcoma of the orbit.** *Ophthalmologica* 121:125-129, Feb.-March, 1951.

A rapidly growing orbital tumor in a 6-year-old girl was extirpated through an upper-temporal orbital rim incision. Histologically, the tumor proved to be a reticulosarcoma. Postoperative radiation consisted of 9 doses of 300 r each. Three years later the child was living and well, the eyeball on the operated side functioning and moving almost normally.

Peter C. Kronfeld.

Fricke, R. E., Van Herik, M., and Henderson, J. W. **Radium and surgical treatment of retinoblastoma.** *Surg. Clin. North America* pp. 1147-1155, Aug., 1951.

It is safer to perform bilateral enucleations when both eyes are involved. If the neoplasm is less than two disc diameters in size, not elevated more than three diopters, not located near the optic nerve, and if the vitreous is clear, and a white reflex not visible through the pupil, the tumor may be amenable to irradiation. Intracavitary optic radon applicators are used. The sclera will tolerate up to 20,000 gamma radiations and between 2,000 and 3,500 gamma roentgenrays may be given. With the use of radium 45 percent of the patients remained well after five years, whereas with enucleation 50 percent were apparently cured. Irwin E. Gaynon.

Herszenderfer, A. **One hundred cases of tumors of the eye, treated in the Cancer Institute in Gliwice.** *Klinika Oczna* 20: 385-390, 1950.

In 100 cases of tumor of the eye seen between July, 1947 and May, 1950, 85 were of the lids and of these 84 were cancers; 37 of these cancers were in the inner canthus. There were 10 cases of tumor of the orbit. Cancer was treated surgically or by X ray; radium was used in two cases of orbital tumor. The author discusses different methods of treatment and shows a photograph of the ocular shields used in X-ray treatment.

Sylvan Brandon.

Johnson, M. H., and Steiner, M. B. **Malignant melanoma of the retained blind eye.** *Portland Cl. Bull.* 5:37-38, Sept., 1951.

When the interior of an eye cannot be adequately examined it is important to consider the possibility of malignant melanoma. This tumor may have been the cause of the sequence of events that led to degeneration of the eyeball and to blindness and it is at least possible that irritation in the degenerating eyeball may have stimulated neoplasia. In any event

it is important to realize that the occurrence is not extremely rare even in patients in the second or third decade of life.

F. H. Haessler.

King, E. F., and Ashton, N. **Lymphoma of the conjunctiva.** *Tr. Ophth. Soc. U. Kingdom* 69:301-307, 1949.

In a man, 22 years of age, polypoid masses of varying size and shape arose from the conjunctival fornices, plica semilunaris and from the bulbar conjunctiva in each eye. There was no irritability, pannus or discharge. Biopsy suggested reticulosarcoma but clinically the lesion was thought to be polyposis. There was no history of recent allergy. There was a well circumscribed mass of mature lymphocytes, containing a few blood vessels with intact walls, no polymorphonuclear cells, eosinophils or plasma cells. Reticulin fibers were not seen, mitotic figures were absent. The pathologist classified the mass as lymphoma occurring without constitutional disease. (4 figures)

Beulah Cushman.

Weyand, R. D., MacCarty, C. S., and Wilson, R. B. **The effect of pregnancy on intracranial meningiomas occurring about the optic chiasm.** *Surg. Clin. North America* pp. 1225-1233, Aug., 1951.

Ten cases of meningiomas associated with pregnancy are presented. In four cases there was a marked temporary abatement of symptoms following the post-partum period. The symptoms of intracranial meningioma may first appear during pregnancy and the progression of symptoms may be accelerated. It has been suggested that although it is clear that the size of meningiomas and neurinomas may increase during pregnancy it is quite possible that this enlargement may be ascribed to vascular engorgement or an increase in intracellular fluid. This as-

sumption could explain an increase in size during pregnancy and a decrease after pregnancy is terminated. (2 figures)

Irwin E. Gaynon.

17

INJURIES

Favory, A., and Sédan, J. **Ocular injuries in boxers.** *Arch. d'opht.* 11:429-456, 1951.

The authors note the frequency of eye injuries among boxers and the paucity of the literature concerning them. The problem has become of great importance in France because of the increasing popularity of the sport. Recent statistics show that there are 12,000 amateur boxers and 600 professionals in the country. The ocular lesions take place either by direct shock, as in lid, conjunctival, corneal, or scleral traumata, or by shock transmitted by the sclera, as in iris tears, lens dislocations, or retinal detachments. The authors consider these injuries in detail according to the structures involved, as follows: 1. brows and orbital margins, 2. lids, 3. the lacrimal passages, 4. the conjunctiva, 5. the cornea, 6. the sclera, 7. the anterior chamber and iris, 8. the lens, 9. the vitreous and retina, and 10. the nerve and optic pathways. Finally the complications of glaucoma and ocular muscle anomalies are discussed. Illustrative case histories are cited under each heading. The authors note particularly the frequency of orbital hyperostoses, wounds of the brows, and corneal and iris traumata, and the relative rarity of cataract and glaucoma. They consider retinal hemorrhages to be frequent and to cause retinal separation. Berlin's edema and transient visual loss due to angiospasm are also considered frequent complications. Protective measures which can be employed are mentioned and surgical problems particularly those in brow in-

juries and in injuries of the superior oblique muscles are discussed.

Phillips Thygeson.

Hughes, W. L. **Immediate care of eye injuries.** *Plast. and Reconstruc. Surg.* 8: 281-287, Oct., 1951.

This article is part of a clinical session of the plastic and reconstructive group on emergency treatment of traumatic injuries. Early investigation of cortisone indicated that it would lessen late ectropions of severe degree from thermal burns. In chemical burns, removal of the surface film and the application of a solution of thrombin, 500 units to 20 cc. as drops instilled into the everted lid lining every hour, has proved efficacious in preventing adhesions. Hughes' new method of lid laceration repair with a tongue-in-groove joint of the lid margin is well shown in six figures, and completely explained in the accompanying legends.

Alston Callahan.

Soderberg, B. N. **Surgical repairs of facial injuries.** *Plast. and Reconstruc. Surg.* 8:208-221, Sept., 1951.

Forty-eight photographs are used to show 20 cases of repairs of facial injuries. This series is presented without attempt at classification or generalization of the work. Unfortunately, long term follow-up photographs and descriptions are not included.

Alston Callahan.

18

SYSTEMIC DISEASE AND PARASITES

Appelmans, M., and Weyts, J. **Ariboflavinosis in the natives of the Belgian Congo.** *Arch. d'ophth.* 11:333-339, 1951.

The authors describe 12 cases of a form of keratitis without vascularization and without associated night blindness but accompanied by cheilosis and glossitis. The lesions were primarily epithelial and con-

sisted initially in a keratosis of the superficial cells with turgescence of the basal cells. Later, exfoliation occurred, and left fluorescein-staining, grayish-opalescent patches, generally oval, with their long axes horizontal. Ciliary injection was minimal or absent and tear function appeared to be reduced. Intravenous injections of 10 mg. of riboflavin resulted in rapid clinical cure. The similarity of these lesions to those described by Metivier and Djacos under the name "epithelial keratopathy" is noted and the possible role of anemia and hypoproteinemia, which occurred in most of the cases is discussed.

Phillips Thygeson.

Bartolozzi, R. **Ocular symptoms of tuberculous meningitis.** *Arch. Soc. oftal. hispano-am.* 11:649-657, June, 1951.

Ophthalmoscopic observation of a choroidal tubercle permits the diagnosis of miliary tuberculosis and tuberculous meningitis; in the latter it is associated with changes in the papilla. Ophthalmoscopic examination in the course of the disease is important because it affords an early recognition of relapses and recurrences and serves as a therapeutic guide. The evolution of a tubercle towards healing is a favorable sign. Changes on the papilla are of great value as indicators of the course of the disease. The appearance of mydriasis and pupillary rigidity are manifestations of an aggravation of the disease process, normalization of the pupils is an indication of improvement. (2 figures)

Ray K. Daily.

Beleke, H., and Bandau, R. **Eye complications in canicola fever.** *Deutsche med. Wchnschr.* 76:729-730, June 1, 1951.

In two cases of infection with the leptospirae there was a conjunctivitis early in the course of the disease. Iritis appeared 14 days after the onset of the disease in one case and 45 days in the other.

Posterior synechiae and vitreous hemorrhages and opacities appeared late. Diagnosis was made by the complement fixation test and was positive in both cases.

H. C. Weinberg.

Brini, A., and Muller, J. **Oculo-glandular tularemia and the conjunctivitis of Parinaud.** Arch. d'opht. 11:462-469, 1951.

The conjunctivitis of Parinaud, although a simple clinical entity, is not an etiologic entity. In France the two most important causes are tuberculosis and tularemia and both produce conjunctival lesions that vary from ulceration to granulations, with transitional forms. Oculo-glandular tularemia is of relatively short duration whereas the tuberculous type lasts many months and leaves cicatricial sequelae. A case of oculoglandular tularemia in a 16-year-old girl is reported in which streptomycin and aureomycin effected a cure in about 15 days. The source of contamination was a wild rabbit. Diagnosis was based on an agglutination titre for *Bacterium tularense* which rose from 1/500 to 1/2,000 in 12 days. Other causes of the oculoglandular syndrome are discussed, including the leptothrix and *B. pseudotuberculosis rodentium*.

Phillips Thygeson.

Engel, H. J. **Experiences with (G T) purified tuberculin and the leucocyte curve in eye diseases where tuberculosis was suspected.** Klin. Monatsbl. f. Augenh. 117:476-495, Jan., 1950.

Engel discusses clinically his use of purified tuberculin which corresponds to our purified protein derivative. It is obtained by precipitation with trichloroacetic acid from heated, bacteria free, filtered and concentrated tubercle bacillus cultures. The results were no better than those in which other types of tuberculin were used. His use of the leucocyte curve

in conjunction with the course and dosage of the tuberculin is discussed.

Theodore M. Shapira.

Herman, E. **Arterial hypertension, the eye and changes in the nervous system.** Klinika Oczna 20:216-223, 1950.

Zelenin divides essential hypertension into presymptomatic, transitory, neurogenic, stable and terminal phases. This division is based on the condition of the blood pressure, cardiovascular system, nervous system, kidney function, appearance of the fundus of the eye and the general condition of the patient. Herman considers this the most satisfactory and only mentions other types of classification superficially. He stresses the symptoms connected with the central and peripheral nervous system. Some of them are functional and are due to vascular spasm which causes stimulation or ischemia and paresis. Organic changes are due to infarcts or hemorrhages. Observation of the changes in the fundus are useful as indications of the changes in the central nervous system. The appearance of the fundus may show changes in the pressure of the cerebro-spinal fluid and edema of the brain tissue.

Sylvan Brandon.

Hollenhorst, R. W. **The ophthalmologic aspects of chronic renal disease.** M. Clin. North America pp. 1023-1039, July, 1951.

Chronic renal disease causes angiospasm and acute hypertensive retinopathy or neuroretinopathy with anemia. These changes appear when the diastolic blood pressure is elevated, and are independent of the existence of azotemia. In contrast to the changes of malignant hypertension, there is anemia and little or no retinal arteriosclerosis. Marked retinal edema is less common in malignant hypertension than in chronic renal disease. In chronic renal disease there may also be acute angiospastic retinopathy. Toxic retinopathy

may be seen in acute, subacute and chronic glomerulonephritis, periarteritis nodosa, and disseminated lupus erythematosus, even in the absence of hypertension. The mean life expectancy in chronic glomerulonephritis in which retinopathy is present is about four to six months as compared to about thirteen months in malignant hypertension, although individual patients may survive much longer. (References) Bennett W. Muir.

Janotka, H. **Essential hypertension and its classification by Keith and Wagener.** *Klinika Oczna* 20:237-240, 1950.

The author examined the eyes of 89 patients with ocular evidence of arterial hypertension and compared the findings with their clinical condition. He concluded that it is not possible, on the basis of the ocular findings alone to determine the degree of hypertension. Only the third degree of hypertensive retinopathy corresponds to the third stage of hypertension. The classification of Keith and Wagener nevertheless is considered to be of help in prognosis and treatment of arterial hypertension.

Sylvan Brandon.

Kirby, T. J. **Ocular phakomatoses.** *Am. J. M. Sc.* 222:227-239, Aug., 1951.

Eleven cases of tuberous sclerosis (Bourneville), 20 of neurofibromatosis (von Recklinghausen), 10 of angiomas (8 von Hippel and 2 Lindau) and 10 nevus flammeus and glaucoma (Sturge-Weber disease) are discussed. A table shows the incidence of ocular, neurologic, and cutaneous lesions as well as calcified and eroded areas found in these four divisions of the phakomatoses. These disease processes are also often accompanied by mental disturbances such as backwardness, imbecility and idiocy, and epilepsy.

Francis M. Crage.

Saphir, W., and Dvore, I. **Uveoparotid fever.** *J.A.M.A.* 147:569-570, Oct. 6, 1951.

Uveoparotid fever is a febrile chronic inflammatory disease of the uvea, with enlargement of the parotid glands, often with facial paralysis. Its etiology has generally been considered tuberculous and by some writers called uveoparotid tuberculosis, while others have thought it a form of sarcoidosis. A clinical case is reported to emphasize the fact that failing vision with uveitis may be sarcoidosis. The patient, a 33-year-old negro woman, had noticed gradual loss of vision for the past six months, and for the past four weeks a chest cold with cough, general weakness and lassitude. General examination was essentially negative and fever did not exceed 100.2°F. On the seventh hospital day a rapidly increasing swelling of both parotid glands occurred. Epidemic parotitis was ruled out. Granulomatous iridocyclitis and a skin eruption of the legs, were present. Marked generalized mediastinal lymphadenopathy, negative dermal tuberculin reaction and a history of exposure to tuberculosis pointed to Boeck's sarcoidosis; there was no bone involvement and no hyperglobulinemia. The fact that failing vision precedes other symptoms by many months is of especial interest to ophthalmologists. Sarcoidosis should be kept in mind when confronted with failing vision and uveitis.

Claude L. LaRue.

Stillerman, M. L. **Ocular manifestations of diffuse collagen disease.** *A.M.A. Arch. Ophth.* 45:239-250, March, 1951.

The author reviews the ocular findings associated with some recognized systemic diseases and then attempts to show the possible implications of the collagen system in some heretofore unsolved ophthalmological problems. Just as there is ocular involvement in these diseases with generalized connective tissue alterations,

so may there be purely ocular diseases due to alterations of the local mesenchymal derivatives. Stillerman suggests that alterations of connective tissues may be responsible wholly or in part for such conjunctival diseases as pemphigus, amyloid degeneration, and rosacea keratoconjunctivitis. Corneal involvement in Fuchs' marginal dystrophy, Mooren's ulcer, pterygium and keratoconus may represent a degeneration of fibrillar, cellular or interfibrillary elements. Other ocular disease entities that might be due to alterations of the local mesenchymal derivatives are wide angle glaucoma, essential atrophy of the iris and choroid, angioid streaks, Eales's disease, and malignant myopia.

E. J. Swets.

Swan, M. M., McClellan, J. W., and Reizman, B. **Choroidal lesion in acute brucellosis which responded to streptomycin and sulfadiazine.** *A.M.A. Arch. Int. Med.* **88**:258-261, Aug., 1951.

A young negro packing house worker became acutely ill after handling infected carcasses. The right eye showed two fluffy, white, acute exudative choroidal lesions above the disc; the larger lesion was as large as the disc itself. After ten days treatment with streptomycin and sulfadiazine his general condition was almost normal. Seven days later the right eye was entirely normal. This seems to be the first case reported in which the ocular lesions of brucellosis showed prompt clearing after specific therapy for the general condition.

Francis M. Crage.

Wettler, Heinrich. **A case of Werner's syndrome.** *Ophthalmologica* **121**:172-174, Feb.-March, 1951.

Werner's syndrome consists of genital hypoplasia, diffuse scleroderma and juvenile cataract. A typical case is reported.

Peter C. Kronfeld.

Witmer, R., **Temporal arteritis.** *Ophthalmologica* **121**:160-163, Feb.-March, 1951.

Temporal arteritis is a systematic vascular disease affecting predominantly but not exclusively the temporal arteries. The first major subjective symptom in a 68-year-old moderately hypertensive man was sudden complete loss of vision in the right eye. Both temporal arteries were found to be irregularly thickened, tortuous and pulseless. The retinal arterioles of both eyes were very narrow and the right retina showed slight peripapillary edema. Biopsy of the left temporal artery revealed complete occlusion by granulation tissue. Shortly afterwards the left eye became blind also.

Peter C. Kronfeld.

20

HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Brown, Josephine. **Use of educational toys in the training of blind preschool children.** *Am. J. Occup. Therap.* **5**:149-152, July-Aug., 1951.

Early acceptance of the child's blindness by the parents is essential in teaching the child the best use of his other senses. All available special educational facilities for both the parents and the child should be used. Noise making toys, and those that teach comprehension of size, shape and distance are important. A list of toys available for teaching and training from infancy through the age of five is given.

H. C. Weinberg.

Clark, Graham. **Need for occupational therapy in retinal detachments.** *Am. J. Occup. Therap.* **5**:137-139, July-Aug., 1951.

The anatomy of the retina and vitreous and the causes of retinal detachments are explained. Fear of going blind and fear for the future may be treated by the doc-

tor's discussion with the patient. The occupational therapist and the nurse must treat worry and boredom. They should try all sorts of mental stimulants as early as possible.

H. C. Weinberg.

Griggs, Norman. **Independent foot travel for the blind with the use of the cane.** *Am. J. Occup. Therap.* 5:156-158, July-Aug., 1951.

Each case must be considered as an individual problem. The general physical condition, age, native ability and need to get around alone must be evaluated. Alertness and initiative are to be encouraged. The proper weight and length of the cane and its "normal position" aid the patient to walk in a straight line. The "White Cane Law," now in operation in many states requires a motorist to stop when a person with a white cane is crossing the street but it cannot be depended upon to make such crossings safe.

H. C. Weinberg.

Hulek, Aleksander. **Selection of types of occupation for the blind in industry.** *Klinika Oczna* 20:332-351, 1950.

The author estimates that there are in Poland about 6,400 blind between the ages of 20 and 55. About 1,200 are gainfully employed, 800 are in industry. Industrial work for the blind can be divided into two groups: machine work and hand work. Machine work may be on power-driven or on hand-operated machines; hand work may be of the assembly line type. The main characteristic of work suitable for the blind is the repetitious nature of the movements involved so that it may eventually become automatic. Where conditions and requirements change frequently, and where there is a necessity for physical and mental concentration on a very small segment of work the blind should not be employed. The trained blind can do as good a job as a seeing person; 85 percent

have normal productivity and 23 percent above normal. It takes two to four weeks to train a blind person for a simple industrial job. More complicated jobs require very long schooling, but blind persons should not be considered totally disabled.

Sylvan Brandon.

Junès. **Visual acuity and military service.** *Arch. d'opht.* 11:358-369, 1951.

The author considers the relationship between visual acuity and aptitude for military service and presents tables to show the present visual requirements of the various branches of the French military forces. He considers the comparative values of the different visual acuity scales as expressed in ordinary fractions (Snellen 1862, De Wecker 1877), decimal fractions (Monoyer 1874, Parinaud 1888, Landolt 1889), and whole numbers (Armaignac 1906). A table compares the three systems and the visual angles concerned. Malingering may be detected by various methods. For the two most common types seen in military practice, namely the total loss of vision in one eye, and unilateral or bilateral lowered acuity, he prefers the method of Bravais (*Bull. et Mem. Soc. Fr. d'Opht.* 1884, p. 166) for the total loss of vision in one eye, and the method of Thibaudet for the lowered acuity (*Arch. d'Opht.* 1923, p. 105). These methods are described in detail.

Phillips Thygeson.

Kubatko, Eugeniusz. **Results of the anti-trachoma campaign in the district of Zywiec.** *Klinika Oczna* 20:414-418, 1950.

In the district of Zywiec, 17,000 school children were examined in 1949 and 200 cases of trachoma were found; in 6,248 adults there were 378 cases of trachoma and 651 persons were treated for trachoma. Of 1,229 patients 1,029 were cured within a year. Sulfathiazole ointment, 10 percent, was used for 10 days before and

after removal of the trachoma follicles and an intensive program of hygiene and preventive measures was explained to the patients.
Sylvan Brandon.

Merz, Marian. **New problems of industrial ophthalmology.** Klinika Oczna 20:352-357, 1950.

Industry has long been interested in the prevention of eye injuries but prevention of eye strain is a more recent project. Proper lighting of plants, proper utilization of contrasts and the use of different colors are important and fluorescent light is better than the incandescent bulb in industrial work. Colors used appropriately have a favorable psychological effect in production and decrease the number of accidents.
Sylvan Brandon.

Ritter, C. G. **Blindness and functional normality.** Am. J. Occup. Therap. 5:146-148, July-Aug., 1951.

An eagerness to use all possible tools that will be of help in blindness should be awakened in a patient. Braille is a tool and should be taught only to those who actively want to make use of it; for others records can serve as a substitute for reading. If some sight is left special visual aids may be used for specific purposes. In complete blindness good guidance is an

essential in the patient's comfort. He can learn many skills simply by asking himself "how would I do this without looking?" Technical aids may be obtained from the American Foundation for the Blind.
H. C. Weinberg.

Szmyt, J. **Abnormalities and diseases of the eye as the cause of illiteracy.** Klinika Oczna 20:358-360, 1950.

The author examined 500 illiterates and found that 7 had not learned to read because of high refractive errors, 2 had congenitally defective eyes, 5 had eye injuries and 23 had eye diseases. Half of them could be saved from illiteracy with special care.
Sylvan Brandon.

Wellerson, T. L. **Occupational therapy program for eye patients.** Am. J. Occup. Therap. 5:140-145, July-Aug., 1951.

The therapist advises the family to act naturally and to be explicit in their conversation with the patient; to begin training early in order to prevent development of bad habits, to encourage the patient to do as much as he can for himself and to teach the patient to perform his daily needs such as walking, telephoning, and dressing as early as possible.

H. C. Weinberg.

OPHTHALMIC MINIATURE

There are some persons who can see to a very great distance, while there are others, again, who can only distinguish objects when brought quite close to them. The vision of many stands in need of the rays of the sun; such persons cannot see on a cloudy day, nor yet after the sun has set. . . . Blue eyes are the best for seeing in the dark.

Pliny the Elder (Caius Plinius Secundus)
Historia Naturalis, 78 A.D. (Book 11; Chap. 54)
From the translation of Bostock and Riley.

NEWS ITEMS

Edited by DONALD J. LYLE, M.D.
601 Union Trust Building, Cincinnati 2

News items should reach the editor by the 12th of the month but, to receive adequate publicity, notices of postgraduate courses, meetings, and so forth should be received at least three months before the date of occurrence.

DEATHS

Dr. Walter B. Lancaster, aged 88 years, died in his sleep at his home in Boston, Massachusetts, on December 9.

ANNOUNCEMENTS

CHICAGO CLINICAL CONFERENCE

The Chicago Ophthalmological Society has announced that the fourth annual clinical conference will be held Thursday, Friday, and Saturday, February 21 through 23, 1952, at the Drake Hotel.

The first day will be devoted to surgical clinics at various Chicago hospitals. On the following days there will be symposiums on cataract surgery and recent advances in therapeutics followed by round-table luncheons. Additionally, there will be lectures concerning neuro-ophthalmology, ocular pharmacology, nystagmus, provocative tests in glaucoma, and the secretion of aqueous.

Participants include Dr. Alton E. Braley, Iowa City; Dr. Justin M. Donegan, Dr. Joseph S. Haas, Dr. Peter C. Kronfeld, Dr. James E. Lebensohn, Chicago; Dr. Irving H. Leopold, Philadelphia; Dr. John M. McLean, New York; Dr. Samuel J. Meyer, Dr. Maurice D. Pearlman, Chicago; Dr. C. Wilbur Rucker, Rochester, Minnesota; Dr. Derrick Vail, Chicago; and Dr. Joseph A. C. Wadsworth, New York.

Further information concerning the conference may be obtained from Miss Maud Fairbairn, 8 West Oak Street, Chicago 10, Illinois.

The conference will be followed by a banquet and the eighth annual Sanford R. Gifford Memorial Lecture to be presented by Dr. Alton E. Braley, professor and head of the Department of Ophthalmology, The State University of Iowa. Dr. Braley will speak on "Experimental studies of the herpes simplex virus." The banquet and lecture will be at the Drake Hotel and all are invited. Dinner reservations may be obtained from Miss Fairbairn.

GRANTS FOR RESEARCH AVAILABLE

The National Society for the Prevention of Blindness has limited funds available for grants for basic laboratory or clinical research projects that may add to understanding the etiology of blinding eye disease or improve methods of diagnosis, treatment, or prevention. To be considered, applications should be received before April 1, 1952. Forms may be obtained from the National Society for the Prevention of Blindness Research Committee, 1790 Broadway, New York 19, New York.

MEMPHIS CONVENTION

The Memphis Eye, Ear, Nose, and Throat Society's postgraduate meeting will be held on February 9, 10, and 11, 1952, at the Hotel Peabody, Memphis, Tennessee.

Guest speakers on ophthalmology will be: Dr. Algernon B. Reese, New York, who will speak on: "Practical application of anatomy of the eye," "Treatment of tumors of the eye," "Cataract extraction," and "Gleanings." Dr. Alan C. Woods, Baltimore, whose subjects will be: "The action of ACTH and cortisone in ophthalmology," "Effects of growing insurance program on the training of residents," "Modern treatment of ocular tuberculosis," and "The role of streptococcus hypersensitivity in uveitis." Dr. John F. Gipner, Rochester, New York, will discuss: "Classification of hypertension," "Recent advances in ophthalmic surgery," "The interpretation of visual fields in neurotic patients," and "Recent advances in ophthalmology."

Further information may be obtained from Dr. Roland H. Myers, 1720 Exchange Building, Memphis, Tennessee.

SURGEONS SECTIONAL MEETING

Dr. Robison D. Harley, 101 South Indiana Avenue, Atlantic City, New Jersey, is chairman of the sectional meeting of the American College of Surgeons to be held at Haddon Hall, Atlantic City, on February 12, 1952.

On the program will be: "Surgery of ocular trauma," Dr. Irving H. Leopold, Philadelphia; discussor, Dr. William C. Owens, Baltimore. "A consideration of the incidence of ocular tumors," Dr. Edmund B. Spaeth, Philadelphia; discussor, Dr. John McGavie, Philadelphia.

"Curare akinesia in cataract surgery," Dr. John Warren Henderson, Rochester, Minnesota; discussor, Dr. Wilfred Fry, Philadelphia. "Indications for variations in routine cataract operation," Dr. P. Robb McDonald, Philadelphia; discussor, Dr. James Shipman, Camden, New Jersey.

"The present status of buried and semiburied implants," Dr. Norman Cutler, Wilmington, Delaware; discussor, Dr. Benjamin Souder, Reading, Pennsylvania. "Diagnosis and management of superior oblique underaction," Dr. John M. McLean, New York; discussor, Dr. William P. McGuire, Winchester, Virginia; "Cataract extraction: Usual procedures in uncomplicated cases; usual procedures in complicated cases," Dr. Ramón Castroviejo, New York; discussor, Dr. Walter S. Atkinson, Watertown, New York.

MEDITERRANEAN CRUISE

The Brussels Medical Society is sponsoring a cruise on the luxury liner "Champollion," which will leave Marseilles on April 5, 1952, will visit Spain, the Balearic Islands, Madeira, the Canary Islands, Santa Cruz, and Casablanca and will return to Marseilles April 22nd. It is hoped that physicians of many nations may join the cruise in order to cement international friendships. Depending on accommodations, £120 to £300 per person covers all but personal expenses. For details and reservations interested physicians should write as promptly as possible to "Bruxelles-Medical," 29 Boulevard Adolphe Max, Brussels, Belgium.

MISCELLANEOUS

YALE GRADUATE-COURSE SPEAKERS

Dr. Arthur Unsworth, ophthalmic surgeon at Hartford Hospital, was guest lecturer at the Yale postgraduate course in ophthalmology held in The Grace-New Haven Community Hospital on November 10, 1951. Dr. Unsworth spoke on "Retrolental fibroplasia," covering the history of the disease, his observations, and the incidence at the Hartford Hospital.

Dr. Sylvia P. Griffiths spoke on the incidence in a six-year study at The Grace-New Haven Hospital. Dr. Raymond B. Griffiths discussed anatomic aspects of retrolental fibroplasia. Dr. Rocko M. Fasanella told of a new theory based on his observation of this six-year follow up and of how he felt retrolental fibroplasia might be reproduced in the experimental animal.

A discussion followed in which Dr. David Freeman spoke of the pathologic differences of the disease in prematurity. Dr. Leon S. Stone, Bronson professor of comparative anatomy, discussed anatomic aspects of the developing eye. Dr. Arnold Gesell, professor emeritus of child hygiene and director of the Clinic of Child Development, commented on the developmental problems concerned with cases of retrolental fibroplasia that he is following. Dr. Arthur Yudkin suggested the baby rat as a good experimental animal for the reproduction of eye lesions. Dr. Eugene Blake commented briefly on the problem of retrolental fibroplasia.

JOURNAL BACK ISSUES WANTED

The JOURNAL has received a request for complete volumes of Series III through 1950 and for single copies of the issues of August, 1942, and September, 1948. Anyone having such volumes or issues for sale please write: The Ophthalmic Publishing Company, 664 North Michigan Avenue, Chicago 11, Illinois.

SOCIETIES

BIRMINGHAM SECTIONAL MEETING

A sectional meeting of the American College of Surgeons was held at Birmingham, Alabama, on January 10th, 11th, and 12th. Dr. Thomas O. Paul, Birmingham, presided at the ophthalmology program which included the following papers:

Dr. Charles J. Burnham, Birmingham, "Glaucoma in industry"; Dr. John O. Martin, Birmingham, "A study of orbital implants used by the Thigpen-Cater Eye Hospital, 1948-1951"; "Symposium on malignant exophthalmos"; Dr. Arthur M. Freeman, Birmingham, "Medical aspects"; Dr. Donald B. Sweeney, Birmingham, "Neurosurgical aspects"; Dr. Beamon Cooley, Jr., Birmingham, "Ophthalmological aspects."

A motion picture on "Cataract and glaucoma: Extraction via inferior route," was also presented.

READING MEETINGS

At the 117th regular meeting of the Reading (Pennsylvania) Eye, Ear, Nose, and Throat Society, a study club was conducted on the subject of "Allergic rhinitis." The moderator was Dr. James E. Landis, Reading, and the instructors, Dr. John J. Penat and Dr. Carl M. High, Reading.

Members, present at the 56th Academy meeting in Chicago, reporting on the courses and lectures were: Dr. Paul C. Craig, Dr. James E. Landis, Dr. James H. Parker, Jr., Dr. John J. Penta, Dr. J. Van Dyke Quereau, Dr. Benjamin F. Souders, and Dr. Philip R. Wiest.

The 118th regular meeting of the Reading society was held at the Wyomissing Club. Dr. David Myers, Philadelphia, spoke on "Modern therapy of sinusitis and sinus surgery today." Dr. Paul C. Craig was moderator for the study club discussion of the subject, "Medico-legal and compensation problems and complications." The instructors were Dr. David N. Farber, Reading, and Dr. Robert R. Muschlitz, Slatington, Pennsylvania.

PERSONALS

Dr. Lawrence T. Post, Saint Louis, presented the first annual Thigpen lecture at the Medical College of Alabama, Birmingham, on December 19, 1951. The subject of Dr. Post's address was "The prevention of secondary glaucoma after cataract surgery: Report of 300 cases."

The Leslie Dana Medal for the Prevention of Blindness was awarded to Dr. E. V. L. Brown, Chicago, on December 7th at a dinner in Saint Louis. Sponsoring the award were the Saint Louis Society for the Blind, the National Society for the Prevention of Blindness, and the Association for Research in Ophthalmology.

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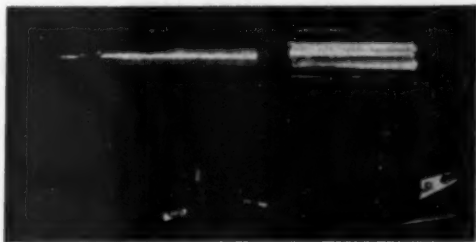
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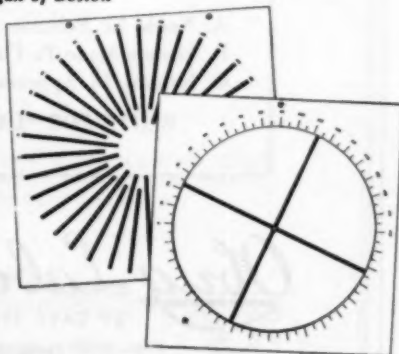
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¹ Crook, P., Carpenter, C. C., Klenz, P. F. *Science* 112:656 (12-1, 1950)

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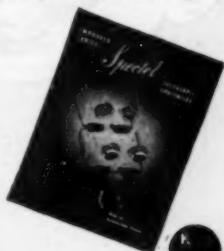
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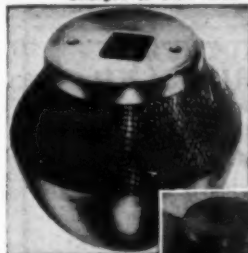
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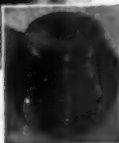
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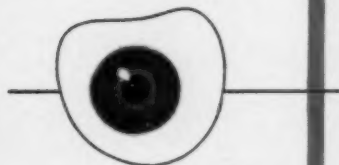
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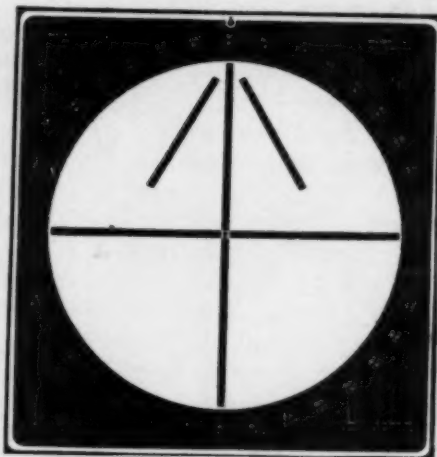
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